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TERATOLOGY OF PHILIPPINE ORCHIDS[1]

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THREE PLATES

In the course of studying Philippine orchids the author observed a number of abnormalities in orchid flowers, and it was thought best to record these observations as they were met. The present paper contains descriptions of a number of monstrosities in Philippine orchids which have been collected from time to time since 1931 by the author and his friends. In this connection the author desires to express his sincere thanks to Mrs. Remedios C. Gonzales and Mrs. K. B. Day, both of Manila.

ERIA BRACTESCENS Lindl. Plate 1; Plate 3, figs. 1 and 2.

Reversion, condensation, and suppression of floral organs are common teratological disturbances in Orchidaceæ, but the presence of two labella in a flower as far as the author is aware has not been reported in any *Eria*. *Eria bractescens* is common in the Philippines and is often sold in Manila by orchid peddlers. This particular plant had many flowers with two labella instead of one, grown together laterally.

PHALAENOPSIS APHRODITE Reichb. f.

Cases of fine pelories were reported by Costerus and Smith[2] in *Phalaenopsis amabilis* where the labellum and the petals are alike without any incision or appendage and the column wanting. Masters[3] also reported teratological cases in *Phalaenopsis schilleriana* and *P. amabilis*, but neither of them mentioned the kinds of pelories here described. The following deviations have been observed:

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[1] The first paper on teratology of orchids was published by the author in Orchid Review 39 (1931) 131.

[2] Ann. Jard. Bot. Buitenzorg 28 (1914) 133, t. 26, fig. 14.

(1) One of the plants of *Phalaenopsis aphrodite*, collected by Mr. M. Ramos from Mount Iraya, Batanes, that flowered in the Bureau of Science orchid house, Manila, March 16, 1932, had a very peculiar column. All the floral segments were normal in size and form, with the exception of the column which was winged. The wing appeared like a petaloid organ (Plate 3, figs. 3 and 4).

(2) In the collections of Mrs. K. B. Day of *Phalaenopsis aphrodite* Reichb. f., there appeared a flower which was characterized by the complete suppression of the left petal (Plate 3, figs. 5 and 6). The absence of the left petal was accompanied by a slight increase in the size of the lateral sepals; the right petal present was normal. The labellum was normally developed. On the lateral side of the column there was an extra anther (Plate 3, fig. 6).

PHALAENOPSIS EQUESTRIS (Schauer) Reichb. f. Plate 3, figs. 7, 8, and 9.

The flower is dimerous and is about 2.8 cm across. The dorsal sepal, petals, and column are normally developed. The lateral sepals coalesced into one, in form quite like the dorsal sepal but larger. The coalesced structure is elliptic in shape and strongly concave at the tip. The specimen is also unique in the complete absence of the labellum. The specimen was collected from a plant belonging to Mrs. Remedios C. Gonzales.

PHALAENOPSIS SCHILLERIANA Reichb. f. Plate 2; Plate 3, figs. 10 and 11.

Cases similar to that in *Phalaenopsis aphrodite* (figs. 3 and 4) were observed in *Phalaenopsis schilleriana*. The wings here, however, were more developed, and appeared like a tumor enveloping the column as in fig. 11.

PHALAENOPSIS STUARTIANA Reichb. f. Plate 3, fig. 12.

This abnormality appeared in one of the many plants which flowered in the summer of 1932 in the Bureau of Science orchid house. At the base of the front lobe of the labellum an extra appendage or lobe was produced, linear-oblanceolate in form. The extra lobe was a chip of the front lobe and not of the lateral lobes.

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[3] Vegetable Teratology (1869) 262.

SPATHOGLOTTIS PLICATA Blume. Plate 3, figs. 13 and 14.

Costerus and Smith[4] mentioned a case in this species showing transformation of petals into labella. The lateral sepals, the left petal, labellum, and column were all normal. The dorsal sepal, however, was intimately united with the right petal, forming a single structure, which was very cucullate.

VANDA SANDERIANA Reichb. f. Plate 3, figs. 15 and 16.

This is a case of synanthy of two flowers. The floral organs—petals, sepals, and labella—are slightly smaller than the typical and normal ones. The pedicel is single, but the ovary is forked. There are four petals, two dorsal sepals, four lateral sepals, and two columns.

[4] Ann. Jard. Bot. Buitenzorg 28 (1914) 134.

ILLUSTRATIONS

PLATE 1

Eria bractescens Lindl., racemes with double-lipped flowers, slightly reduced.

PLATE 2

Phalaenopsis schilleriana Reichb. f., flowers with winged columns, slightly reduced.

PLATE 3

FIG. 1. *Eria bractescens* Lindl., front view of flower with two lips, × 1.
2. *Eria bractescens* Lindl., side view of flower with two lips, × 1.
3. *Phalaenopsis aphrodite* Reichb. f., side view of column, × 2.
4. *Phalaenopsis aphrodite* Reichb. f., front view of column, × 2.
5. *Phalaenopsis aphrodite* Reichb. f., front view of a flower showing absence of one of the petals and enlargement of lateral sepals, × 0.5.
6. *Phalaenopsis aphrodite* Reichb. f., front view of column showing two fused anthers, × 2.
7. *Phalaenopsis equestris* (Schauer) Reichb. f., side view of flower, × 1.
8. *Phalaenopsis equestris* (Schauer) Reichb. f., front view of a flower, × 1.
9. *Phalaenopsis equestris* (Schauer) Reichb. f., view of fused lateral sepal from above, × 1.
10. *Phalaenopsis schilleriana* Reichb. f., front view of winged column, × 2.
11. *Phalaenopsis schilleriana* Reichb. f., front view of another winged column, × 2.
12. *Phalaenopsis stuartiana* Reichb. f., labellum stretched out, viewed from above, showing appendage, × 1.
13. *Spathoglottis plicata* Blume, front view of flower showing fused dorsal sepal and petal, × 1.
14. *Spathoglottis plicata* Blume, side view of flower, showing fused dorsal sepal and petal, × 1.
15. *Vanda sanderiana* Reichb. f., a double flower, × 0.5.
16. *Vanda sanderiana* Reichb. f., two labella and two ovaries with one single pedicel, × 0.5.

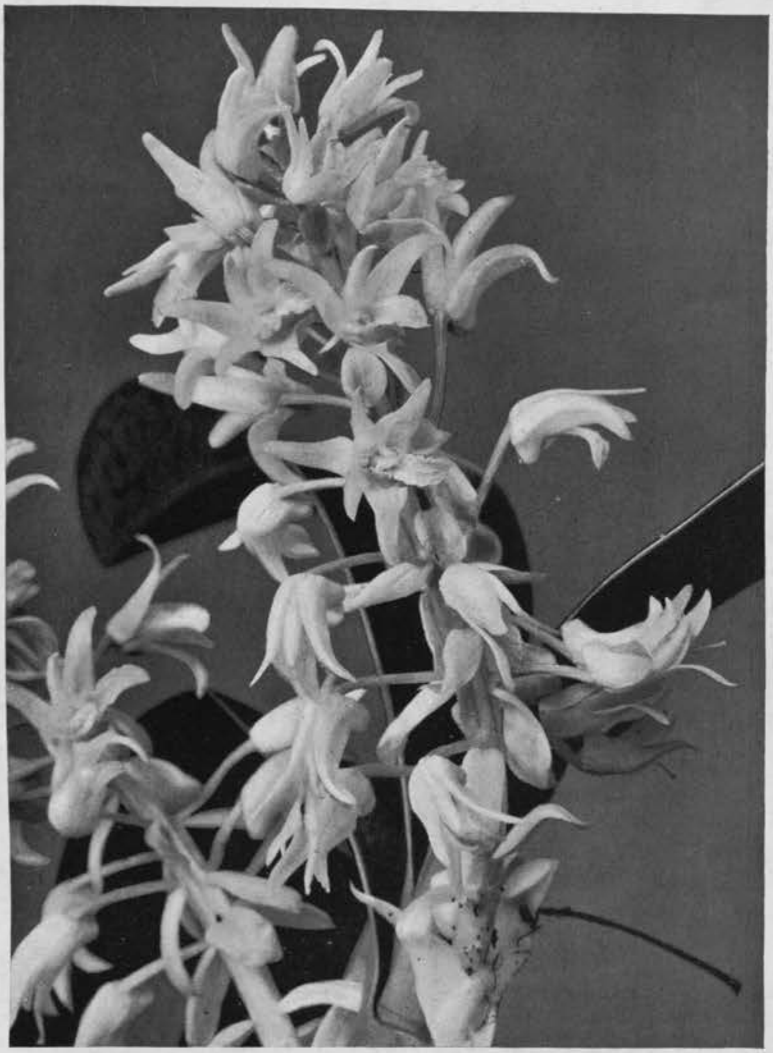

PLATE 1.

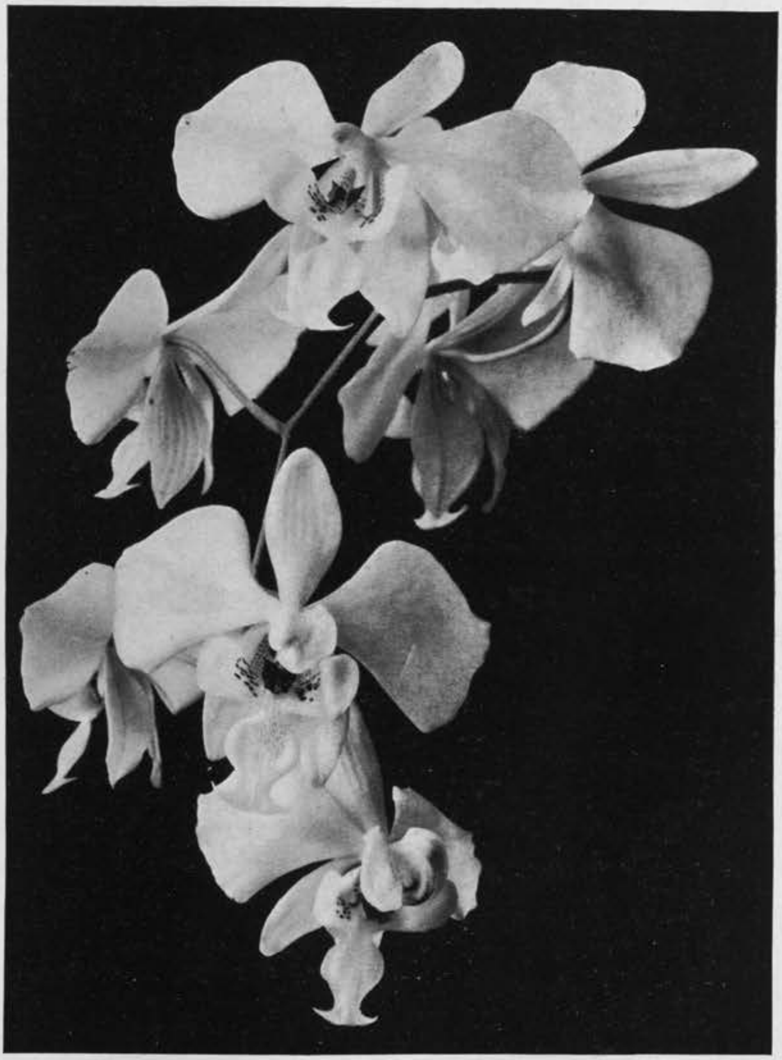

PLATE 2.

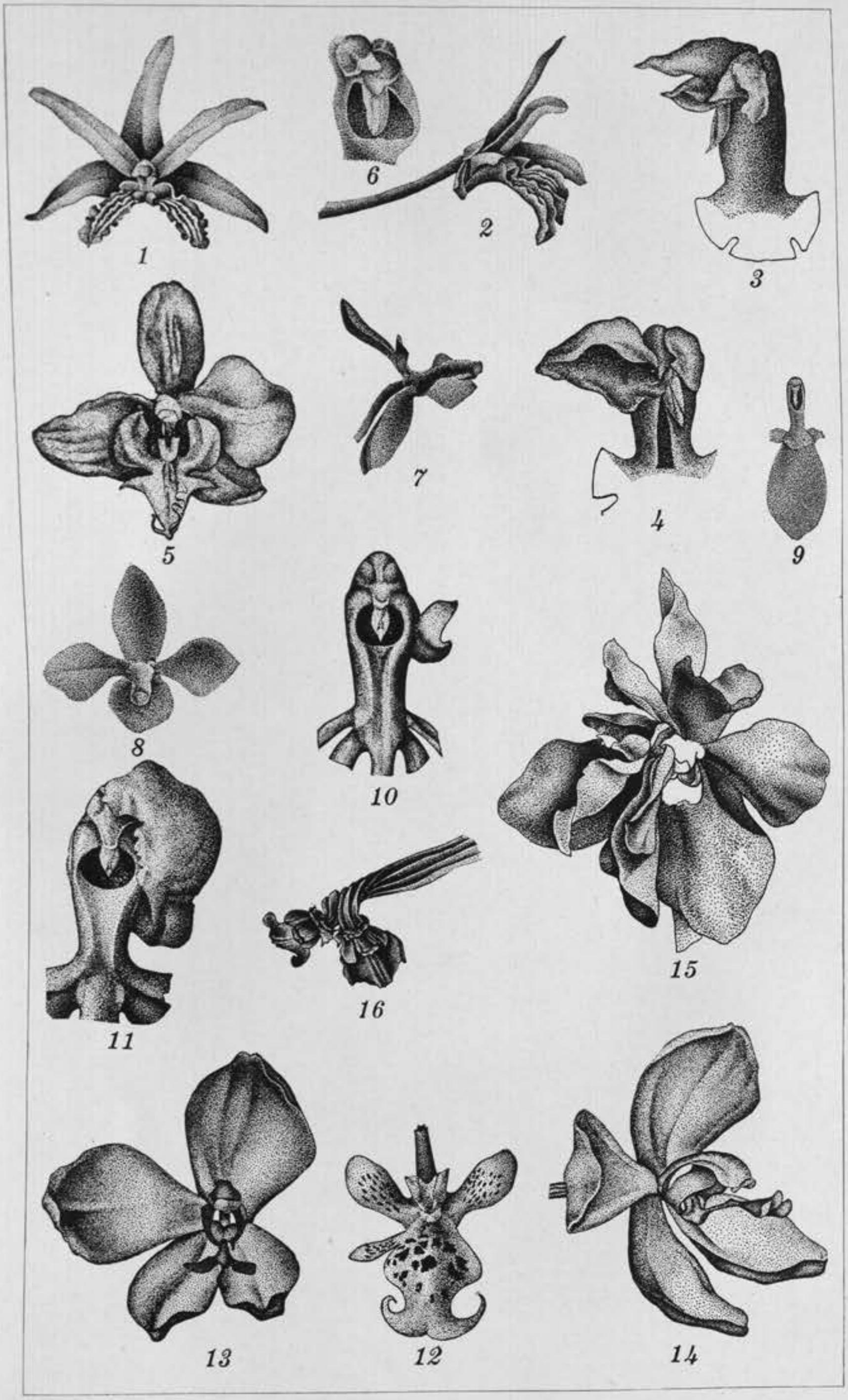

PLATE 3.

A MONOTYPIC PLANT ORDER NEW TO THE PHILIPPINE FLORA

By H. J. Lam

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In 1909 the well-known plant collector A. D. E. Elmer discovered in the forests on the slopes of Mount Apo, Todaya, Davao district, Mindanao, Philippine Islands, a tree, which he considered to be a new species of the myrsinaceous genus *Discocalyx.* The plant was found "in ravines or upon ridges of secondary forests from 2,500 to 3,750 feet elevation" and described under the name *Discocalyx macrocarpa* Elmer,[1] being represented in various herbaria, and also in that of the Buitenzorg Botanical Gardens, by copies of its three type specimens; namely, *Elmer 10553* (flow. buds), *10660* (flow.), and *11867* (fruits).

Merrill[2] pointed out that, in his opinion, the species in question could not belong to the genus *Discocalyx,* since it showed many features in which it is quite different from the other species of that genus. He, therefore, proposed to raise it to generic rank and created the name *Apoia* for the new genus, the specific name thus becoming *Apoia macrocarpa* (Elm.) Merr. It seems worth while to quote Merrill's comment concerning this alteration:

> The original description is very long, yet several very important characters are not mentioned, these being the presence of staminodes alternating with the stamens; the 2-celled ovary, each cell with a single basal ovule; and the often 2-seeded fruit. The peculiar appendiculate-glandular petiole character is mentioned although this is not emphasized. At the junction with the lamina each petiole is provided with one, or more usually two,[3] rather stout, spreading or subappressed, appendaged glands, these often being 1 mm or more in length.

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[1] Leaflets of Philippine Botany Art. 115 8 (March 27, 1915) 2781–3.

[2] Philip. Journ. Sci. 17 (1920) 605–6.

[3] As far as I know there are, as may be expected, always two of such appendages, but only in two *Sarcosperma* species; namely, *S. paniculatum* Stapf and King and *S. breviracemosum* H. J. Lam.—H. J. L.

> I do not consider that the species can possibly be placed in *Discocalyx*, and it is so anomalous in the Myrsinaceae that I am by no means certain that it really belongs in this family, although in spite of its anomalous characters it seems to be better placed here than in any other group. The entire absence of the punctate glands in the vegetative[4] and floral organs; its 2-celled ovary, each cell with a single basal ovule; its ellipsoid, 2- or, by abortion, 1-seeded fruits; and its appendiculate-glandular petioles are anomalous characters in the Myrsinaceae, while staminodes are rare in the group, being confined to the quite unallied genus *Rapanea*. If it is properly placed in the Myrsinaceae, it is probably as close to *Discocalyx* as to any other proposed genus.

The same view is expressed in a later publication of the same author,[5] in which he retains the name *Apoia macrocarpa*, but with the addition: "A monotypic genus, perhaps, however, not belonging in this family."

In December, 1931, one of the ablest native clerks of the Buitenzorg Herbarium, Sapiin, to whose experience this institution owes many valuable indications, suggested that *Apoia* actually could not be placed in the Myrsinaceæ and asked whether it could be related with the Sarcospermaceæ. On comparing the specimens of *Apoia* with those of *Sarcosperma*, I elaborated several years ago,[6] it stood clear at once, as, for the rest, could have been evident from Merrill's observations, that *Apoia* must be identical with *Sarcosperma* and *Apoia macrocarpa* with *Sarcosperma paniculatum* Stapf and King. As to the differences from the Myrsinaceæ I may add to Merrill's points that the anthers are distinctly extrorse (Merrill says: "basifixae . . . . subintrorsae . . . ."), in the Myrsinaceæ they are always introrse—and that the leaves are often subopposite. The fact that *Sarcosperma* has been inserted not only in the Sapotaceæ, but also in the Myrsinaceæ, evidences both its close relation to those two families and its isolation from them, since its characters render it quite distinct from any genus in either of the orders mentioned.

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[4] Some *Sarcosperma* species, such as *S. paniculatum* Stapf and King and *S. arboreum* Hook. f., possess small glands (pits) on the lower surface of the leaves, either dispersed or in the axils of the secondary nerves.—H. J. L.

[5] Enumeration of Philippine Flowering Plants. Manila 3 (1923) 270.

[6] Lam, H. J. The Sapotaceae, Sarcospermaceae and Boerlagellaceae of the Dutch East Indies and surrounding countries, Bull. du Jard. Bot. de Buitenzorg III 7 (1925) 248–250, fig. 64; Concise Revision of the Sarcospermaceae 8 (1926) 18–24, figs. 1–2.

The genus *Sarcosperma* was created by Hooker f., in 1876,[7] and thus invalidates *Apoia* (1920), as the specific name *macrocarpa* (1915) is invalidated by that of *paniculatum* (1901). Both genus and family are new to the Philippine flora. At present the Sarcospermaceæ are known to occur in southeastern Asia, continent (5 species, in China, Hong Kong, Tonkin, Assam, and Sikkim) and in the Malay Peninsula and Archipelago (4 species, in the Peninsula, Sumatra, Mindanao, and Ternate). *Sarcosperma paniculatum* is now known from the Malay Peninsula, Sumatra, Mindanao, and Ternate. Considering that the only other *Sarcosperma* species with the petiolar appendages—namely, *S. breviracemosum* H. J. Lam, which is known from Sumatra and Flores (Lesser Sunda Islands) only—differs from the first-named species only by its extremely small inflorescences and therefore possibly hardly deserves the specific rank next to *paniculatum,* we may, perhaps, suppose that *S. paniculatum* is one of those species which, covering a large area but nowhere being common, must be considered either as old forms that are due to disappear or, which in the present case seems to be more likely, as young and much-specialized (or reduced) forms which then possibly have to be supposed to originate polyphyletically from another (sapotaceous?) species.

I add a concise conspectus of the order, as far as the Philippines are concerned:

SARCOSPERMACEÆ

Sarcospermaceae H. J. LAM, Bull. Jard. bot. Buitenzorg III 7 (1925) 248. Monotypic.

Genus SARCOSPERMA Hooker f.

Sarcosperma HOOKER f., in Bentham and Hooker f., Gen. Pl. 2^2 (1876) 655; further literature in H. J. Lam, Bull. Jard. bot. Buitenzorg (1925 and 1927).

Bracea KING, Journ. As. Soc. Bengal 2, 54 (1896) 101.

Apoia MERRILL, Philip. Journ. Sci. 17 (1920) 605.

Nine species in southeastern Asia, continent, peninsula, and archipelago as far east as Mindanao, Ternate, and Flores.

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[7] In Bentham and Hooker f., Genera Plantarum 11^2: 655.

In the Philippines only one species:

SARCOSPERMA PANICULATUM Stapf and King.

Sarcosperma paniculatum STAPF and KING, Icon. Plant. 7 (1901), tab. 2690; LAM, Bull. Jard. bot. Buitenzorg III 7 (1925) fig. 64.
Bracea paniculata KING, Journ. As. Soc. Bengal 2, 54 (1896).
Discocalyx macrocarpa ELMER, Leafl. Philip. Bot. 8 (1915) 2781.
Apoia macrocarpa (Elm.) MERRILL, Philip. Journ. Sci. 17 (1920) 605.

MINDANAO, Davao, Todaya, Mount Apo, 750 to 1,100 meters in altitude, *Elmer 10553; 10660; 11867.*

Distribution.—Malay Peninsula, Sumatra, Ternate, Mindanao.

DESMIDS FROM KOREA, JAPAN

By B. W. Skvortzow

Of Harbin, China

FIVE PLATES

The sixty-two desmids recorded in this paper were observed in collections of algæ kindly made for us by Dr. Tameso Mori, professor in Keijo Imperial University, in Korea, Japan, in Seiryori Lake near Keijo in 1926. The number of species is not great, but some are very interesting, conspicuous among which are *Cylindrocystis brebissonii* Menegh. var. *minor* West and G. S. West, *Cosmarium turgidum* Breb. var. *koreana* var. nov., and *Cosmarium willei* Turner.

CYLINDROCYSTIS BREBISSONII Menegh. var. **MINOR** West and G. S. West. Plate 1, fig. 1.

Cells cylindrical, unconstricted, length twice the diameter, apices rounded. Pyrenoids two. Length, 0.03 micron; breadth, 0.015.

GONATOZYGON KINAHANI (Arch.) Rabenh. Plate 1, fig. 2.

Cells twenty-five times longer than their diameter, cylindrical. Apices truncate, cell wall smooth. Length, 0.277 micron; breadth, 0.011.

NETRIUM NAGELII (Bréb.) West. Plate 1, fig. 3.

Cells about four times longer than their diameter, oblong-lanceolate, apices truncate. Length, 0.185 micron; breadth, 0.04.

PENIUM LIBELLULA (Focke) Nordst. Plate 1, fig. 4.

Cells large, six times longer than their diameter, fusiform, subtruncate apices. Cell wall smooth. Length, 0.25 micron; breadth, 0.042.

PENIUM MARGARITACEUM (Ehrenb.) Bréb. Plate 1, fig. 5.

Cells eight times longer than their diameter, subfusiform, constricted in the middle. Cell wall brown, granular. Length, 0.107 micron; breadth, 0.013.

PLEUROTAENIUM TRABECULA (Ehrenb.) Näg. Plate 1, fig. 6.

Cells large, fifteen to twenty times longer than their diameter; semicells with one or two basal inflations. Apices rounded, truncate with tubercles. Cell wall smooth, not punctate. Length, 0.43 to 0.5 micron; breadth at base of semicells, 0.017 to 0.022; breadth of apices, 0.0012 to 0.0015.

PLEUROTAENIUM TRABECULA (Ehrenb.) Näg. forma **CLAVATA** (Kütz.) West and G. S. West. Plate 1, fig. 7.

Cells about twelve times longer than their diameter. Semicells clavate. Length, 0.37 micron; breadth, 0.03; breadth of the apices, 0.015.

PLEUROTAENIUM sp. Plate 1, fig. 8.

Cells large, twenty-three times larger than their diameter. Semicells with a prominent basal inflation. Apices rounded-truncate, destitute of tubercles. Cell wall smooth. Length, 0.23 micron; breadth at base of semicells, 0.085; breadth of apices, 0.006.

CLOSTERIUM TURGIDUM Ehrenb. Plate 1, fig. 9.

Cells large, curved, eighteen times longer than their diameter with distinctly recurved apices. Cell wall finely striated. Length, 0.832 micron; breadth, 0.051; breadth of apices, 0.007.

CLOSTERIUM DECORUM Bréb. var. **MINOR** var. nov. Plate 1, fig. 10.

Cells sixteen times longer than their diameter, curved. Cell wall striated. Distance between apices, 0.173 micron; breadth, 0.011.

CLOSTERIUM INTERMEDIUM Ralfs. Plate 2, fig. 11.

Cells large, twenty-two times longer than their diameter, curved. Cell wall pale yellow, strongly striated. Length, 0.42 micron; breadth, 0.019; breadth of apices, 0.0074.

CLOSTERIUM STRIOLATUM Ehrenb. Plate 2, fig. 12.

Cells large, eight times longer than their diameter, slightly curved, inner margin straight. Apices broad and truncate with rounded angles. Cell wall yellowish, striated. Length, 0.307 micron; breadth, 0.037; breadth of apices, 0.009.

CLOSTERIUM TUMIDUM Jahnson var. **KOREANA** var. nov. Plate 2, fig. 13.

Cells eight times longer than their diameter, slightly curved. Cell wall smooth and colorless, chloroplasts with four ridges. Length, 0.259 micron; breadth, 0.029; breadth of apices, 0.006. This variety is distinguished from *Closterium tumidum* by the longer and broader cells.

CLOSTERIUM MONILIFERUM (Bory) Ehrenb. Plate 2, figs. 15 and 16.

Cells of medium size, seven times longer than their diameter. Cell wall smooth and colorless. Distance between apices, 0.24 micron; breadth, 0.038; breadth of apices, 0.001.

CLOSTERIUM LEIBLEINII Kütz. var. **BOERGESENII** Schmidle. Plate 2, fig. 17.

Cells of medium size, eleven times longer than their diameter. Cell wall smooth. Distance between apices, 0.236 micron; breadth, 0.02.

CLOSTERIUM PARVULUM Näg. var. **ANGUSTUM** West and G. S. West. Plate 2, figs. 18 and 19.

Cells small, ten times longer than their diameter, strongly curved. Cell wall smooth and colorless. Distance between apices, 0.076 to 0.095 micron; breadth, 0.0068 to 0.0085.

MICRASTERIAS DECEMDENTATA Näg. Plate 2, fig. 14.

Cells a little longer than broad. Semicells 5-lobed. Length, 0.064 micron; breadth, 0.061; breadth of isthmus, 0.0085.

EUASTRUM BINALE (Turp.) Ehrenb. forma **KOREANA** forma nov. Plate 3, fig. 20.

Cells minute, about 1.5 times longer than broad, deeply constricted, sinus narrowly linear; semicells subpyramidate, basal angles subrectangular, retuse-emarginate, superior angles apiculate. Cell wall smooth. Length, 0.018 micron; breadth, 0.013; breadth of isthmus, 0.0034.

EUASTRUM DUBIUM Näg. forma **KOREANA** forma nov. Plate 3, fig. 21.

Cells 1.2 times longer than broad, very deeply constricted. Semicells five-lobed; polar lobe short, oblong-rectangular, semicells with two granules. Length, 0.018 micron; breadth, 0.015; breadth of isthmus, 0.0042.

EUASTRUM INSULARE (Wittr.) Roy. Plate 3, fig. 22.

Cells minute, 1.5 times longer than broad, deeply constricted. Semicells three-lobed, subrectangular. Cell wall smooth. Length, 0.018 micron; breadth, 0.013; breadth of isthmus, 0.0034.

EUASTRUM INSULARE (Wittr.) Roy forma **MINUTA** forma nov. Plate 3, figs. 23 and 24.

Cells minute. Semicells somewhat three-lobed; upper half concave. Length, 0.012 to 0.013 micron; breadth, 0.001 to 0.012; breadth of isthmus, 0.0025 to 0.0035.

COSMARIUM OBSOLETUM (Hantzsch.) Reinsch. Plate 3, fig. 25.

Cells elliptic, deeply constricted, semicells semielliptic, basal angles submamillate. Cell wall punctate. Length, 0.03 to 0.047 micron; breadth, 0.032 to 0.047.

COSMARIUM PACHYDERMUM Lund var. **AETHIOPICUM** West and G. S. West. Plate 3, fig. 26.

Cells large, 1.2 times as long as broad, deeply constricted, semicells semielliptic, apices broad. Cell wall punctate. Length, 0.054 micron; breadth, 0.042; breadth of isthmus, 0.017.

COSMARIUM TRILOBULATUM Reinsch. Plate 3, fig. 27.

Cells small, 1.3 times longer than broad, deeply constricted, semicells three-lobed, smooth. Chloroplasts with one pyrenoid. Length, 0.025 micron; breadth, 0.017; breadth of isthmus, 0.005.

COSMARIUM ASPHAEROSPORUM Nordst. var. **STRIGOSUM** Nordst. Plate 3, figs. 28 and 29.

Cells small, about as long as broad, moderately constricted. Semicells broad-acuminate. Length, 0.01 micron; breadth, 0.0085; breadth of isthmus, 0.006.

COSMARIUM SINOSTEGOS Scharschm. var. **OBTUSUS** Gutw. Plate 3, fig. 30.

Cells minute, about 1.5 times as broad as long, deeply constricted. Semicells subhexagonal. Length, 0.012 micron; breadth, 0.01; breadth of isthmus, 0.004.

COSMARIUM MINIMUM West and G. S. West. Plate 3, figs. 31 and 32.

Cells minute, a little longer than broad, deeply constricted. Semicells rectangular. Length, 0.01 micron; breadth, 0.0085; breadth of isthmus, 0.0025.

COSMARIUM RECTANGULARE Grun. var. **KOREANA** var. nov. Plate 3, fig. 33.

Cells of medium size, 1.5 times as long as broad, deeply constricted. Semicells subhexagonal. Length, 0.015 to 0.017 micron; breadth, 0.01 to 0.011; breadth of isthmus, 0.0038 to 0.0042.

COSMARIUM PYGMAEUM Arch. Plate 3, figs. 34 and 35.

Cells small, about as long as broad or a little broader, deeply constricted. Length, 0.01 micron; breadth, 0.011; breadth of isthmus, 0.0025.

COSMARIUM ABBREVIATUM Rasib. Plate 3, fig. 36.

Cells small, 1.2 times longer than broad, deeply constricted. Semicells hexagonal. Length, 0.017 micron; breadth, 0.012; breadth of isthmus, 0.0042.

COSMARIUM UNDULATUM Corda var. **MINUTUM** Wittr. Plate 3, fig. 37.

Cells 1.5 times longer than broad, deeply constricted, semicells undulated. Length, 0.025 micron; breadth, 0.017; breadth of isthmus, 0.006.

COSMARIUM REGNESI Reinsch. Plate 3, fig. 38.

Cells small, about as long as broad, deeply constricted. Semicells rectangular with marginal teeth. Length, 0.01 micron; breadth, 0.009; breadth of isthmus, 0.003.

COSMARIUM PSEUDOARCTOUM Nordst. Plate 3, fig. 39.

Cells small, 1.2 times as long as broad, slightly constricted. Semicells widely subovate. Cell wall smooth. Length, 0.025 micron; breadth, 0.018; breadth of isthmus, 0.007.

COSMARIUM MONILIFORME (Turp.) Ralfs forma **PANDURIFORMIS** Heimerl. Plate 3, fig. 40.

Cells small, about twice as long as broad, slightly constricted. Semicells subcircular. Length, 0.022 micron; breadth, 0.009; breadth of isthmus, 0.007.

COSMARIUM SUBPROTUMIDUM Nordst. var. **GREGORII** (Roy and Biss.) West and G. S. West. Plate 3, fig. 41.

Cells nearly as broad as long, deeply constricted. Semicells trapeziform, subsemicircular. Cell wall with granules, marginal granules in pairs, conical. Length, 0.017 micron; breadth, 0.015; breadth of isthmus, 0.0045.

COSMARIUM PUNCTULATUM Bréb. var. **GRANULUSCULUM** (Roy and Biss.) West and G. S. West. Plate 3, fig. 42.

Cells a little longer than broad, deeply constricted. Semicells oblong-trapeziform rounded angles. Granules distributed over the whole surface. Length, 0.04 micron; breadth, 0.033; breadth of isthmus, 0.012.

COSMARIUM PUNCTULATUM Bréb. var. **SUBPUNCTULATUM** (Nordst.) Börg. Plate 3, fig. 43.

Cells a little longer than broad, very deeply constricted. Semicells oblong-trapeziform, basal angles rounded. Cell wall granulate. Length, 0.024 micron; breadth, 0.022; breadth of isthmus, 0.006.

COSMARIUM FURCATOSPERMUM West and G. S. West. Plate 3, fig. 44.

Cells small, a little longer than broad, deeply constricted. Semicells truncate-semicircular with two series of small granules. Vertical view elliptic. Length, 0.017 micron; breadth, 0.015; breadth of isthmus, 0.004.

COSMARIUM FURCATOSPERMUM West and G. S. West var. **KOREANA** var. nov. Plate 3, figs. 45 and 46.

Cells larger in size and granules more robust. Vertical view elliptic. Length, 0.03 to 0.032 micron; breadth, 0.027 to 0.028; breadth of isthmus, 0.0085.

COSMARIUM TURGIDUM Bréb. var. **KOREANA** var. nov. Plate 4, fig. 47.

Cells very large, 2.5 times as long as broad, slightly constricted. Semicells ovate-truncate, sides convex, apex rounded, punctate. Length, 0.2 micron; breadth, 0.073; breadth of isthmus, 0.06.

COSMARIUM SUBTURGIDUM (Turn.) Schmidle forma **MINOR** Schmidle. Plate 4, figs. 48, 49.

Cells 1.8 times as long as broad, slightly constricted. Semicells widely ovate, apex rounded. Cell wall punctate. Length, 0.076 to 0.099 micron; breadth, 0.041 to 0.042; breadth of isthmus, 0.04.

COSMARIUM WILLEI Turner. Plate 4, fig. 50.

Dysphinctium willei TURNER, in Freshwater Algae of East India, pl. 8, fig. 40.

Cells large, about twice as long as broad, moderately constricted. Semicells widely ovate from broad bases, apex subtruncately rounded. Cell wall furnished with emarginate verrucæ, disposed in regular vertical and horizontal series. Vertical view ovate. Length, 0.068 micron; breadth, 0.03; breadth of isthmus, 0.022. *Cosmarium willei* Turner was described from Bengal, northern India.

COSMARIUM LUNDELLII Delp. var. **CORRUPTUM** (Turn.) West and G. S. West. Plate 4, fig. 51.

Cells large, about as long as broad, deeply constricted. Semicells semicircular, basal angles broadly rounded, apex truncately rounded. Cell wall serobiculate. Length, 0.047 micron; breadth, 0.044; breadth of isthmus, 0.012.

COSMARIUM GEMINATUM Lund var. **ROTUNDATUM** Lütkemüller. Plate 4, fig. 52.

Cells as long as broad, deeply constricted. Semicells oblong and rounded, granulate. Vertical view elliptic, denticulate and warted. Length and breadth, 0.025 micron; breadth of isthmus, 0.0065; thickness, 0.015. This variety was described in 1900 from Ningpo Mountains, central China.

COSMARIUM PSEUDOPROTUBERANS Kirchn. Plate 4, fig. 53.

Cells small, a little longer than broad, deeply constricted. Semicells transversely subelliptic with obtuse lateral angles. Vertical view subelliptic. Cell wall punctate. Length, 0.023 micron; breadth, 0.02; breadth of isthmus, 0.005; thickness, 0.013.

COSMARIUM ORTHOSTICHUM Lund var. **COMPACTUM** West and G. S. West. Plate 4, fig. 54.

Cells as long as broad, deeply constricted. Semicells oblong-elliptic. Granules in vertical and horizontal series. Length and breadth, 0.02 micron; breadth of isthmus, 0.005.

COSMARIUM CONTRACTUM Kirchn. forma **JACOBSENII** (Roy) West and G. S. West. Plate 4, figs. 55 and 58.

Cells about 1.5 times longer than broad, deeply constricted. Semicells subelliptic. Length, 0.025 micron; breadth, 0.017; breadth of isthmus, 0.005.

COSMARIUM VEXATUM West. Plate 4, fig. 56.

Cells a little longer than broad, very deeply constricted. Semicells pyramidate. Granules sparse and subconcentrically arranged. Central area smooth. Length, 0.039 micron; breadth, 0.034; breadth of isthmus, 0.011.

COSMARIUM SUBTUMIDUM Nordst. Plate 4, fig. 57.

Cells about 1.2 times as long as broad, deeply constricted. Semicells pyramidate-semicircular, basal angles rounded. Cell wall minutely punctate. Length, 0.033 micron; breadth 0.024; breadth of isthmus, 0.011.

ARTHRODESMUS CONVERGENS Ehrenb. Plate 5, fig. 59.

Cells 1.2 times broader than long, very deeply constricted. Semicells elliptic, lateral angles furnished with a short spine. Length, 0.029 micron; breadth, 0.037; breadth of isthmus, 0.006.

ARTHRODESMUS PHIMUS Turn. var. **KOREANA** var. nov. Plate 5, fig. 61.

Cells small, about 1.3 as long as broad, deeply constricted. Semicells subhexagonal, sides slightly concave, apex truncate, lateral angles each with a small, short, diverging spine. Side view of semicell subcircular-depressed. Vertical view broadly fusiform-elliptic. Cell wall smooth. Length, 0.01 micron; breadth, 0.007; breadth of isthmus, 0.0045; thickness, 0.005.

XANTHIDIUM CONCINNUM Arch. var. **BOLDTIANA** West. Plate 5, fig. 60.

Cells minute, about as long as broad, deeply constricted. Semicells transversal subhexagonal, lateral angles each furnished with minute spines. Length and breadth, 0.01 micron; isthmus, 0.0025.

STAURASTRUM GRACILE Ralfs var. **NANUM** Wille. Plate 5, fig. 62.

Cells two times longer than broad, slightly constricted. Semicells cup-shaped, lateral margins slightly concave. Vertical view 4 to 5 angular. Length, 0.025 micron; breadth, 0.025 to 0.028; breadth of isthmus, 0.0045.

STAURASTRUM ALTERNANS Bréb. Plate 5, fig. 63.

Cells small, as long as broad, deeply constricted. Semicells oblong-elliptic. Vertical view triangular. Cell wall granulate. Length and breadth, 0.022 micron; breadth of isthmus, 0.007.

STAURASTRUM STIOLATUM (Nag.) Arch. Plate 5, fig. 64.

Cells small, about as long as broad, deeply constricted. Semicells oblong-elliptic, lateral angles rounded. Vertical view triangular, sides convex. Cell wall granulate. Length and breadth, 0.03 micron; breadth of isthmus, 0.011.

STAURASTRUM MUTICUM Bréb. Plate 5, fig. 65.

Cells a little longer than broad, deeply constricted. Semicells elliptic. Vertical view triangular with broadly rounded angles. Length, 0.022 micron; breadth, 0.02; breadth of isthmus, 0.0075.

STAURASTRUM VESTITUM Ralfs var. **KOREANA** var. nov. Plate 5, fig. 66.

Cells about 1.5 times broader than long, deeply constricted. Semicells subfusiform, apex slightly convex with about 6 emarginate spines. Vertical view triangular, with concave margins. Margins with 2 spines. Length, 0.037 micron; breadth, including process, 0.043; breadth of isthmus, 0.007.

STAURASTRUM GRANULOSUM (Ehrenb.) Ralfs. Plate 5, fig. 67.

Cells small, about as long as broad, deeply constricted. Semicells obsemicircular, apex slightly convex, lateral angles with a minute spine. Vertical view triangular. Length, 0.022 micron; breadth, 0.018; breadth of isthmus, 0.007.

STAURASTRUM PARADOXUM Meyen var. **PARVUM** West. Plate 5, fig. 68.

Cells 1.3 times longer than broad, constriction deep. Semicells cup-shaped. Vertical view triangular. Length, 0.025 micron; breadth, 0.017; breadth of isthmus, 0.0042.

STAURASTRUM LEPTOCLADUM Nordst. var. **SINUATUM** Wolle forma **PLANUM** Smith. Plate 5, fig. 69.

Cells a little broader than long, including the processes. Constriction deep. Semicells rectangular, slightly campanulate at the base, upper angles produced to form long, strongly diverging processes. Vertical view fusiform. Length with processes, 0.04 to 0.042 micron; breadth, including processes, 0.0098 to 0.0049; breadth of isthmus, 0.005.

STAURASTRUM CONNATUM (Lund) Roy and Biss. Plate 5, fig. 70.

Cells small, about as long as broad, deeply constricted. Semicells subsemicircular, vertical margin very strongly convex, dorsal margin nearly straight, upper angles with long spines. Vertical view triangular. Length, without spines, 0.017 to 0.018 micron; breadth, 0.018 to 0.02; breadth of isthmus, 0.0035 to 0.004.

STAURASTRUM DILATATUM Ehrenb. Plate 5, fig. 71.

Cells small, about as long as broad, constricted. Semicells cuneiform, apex undulated, slightly rounded. Vertical view quadrangular. Cell wall granulate. Length and breadth, 0.028 micron; breadth of isthmus, 0.006.

STAURASTRUM QUADRANGULARE Bréb. Plate 5, fig. 73.

Cells small, about as long as broad. Semicells rectangular, angles with 4 spines each. Vertical view 4-angled. Length, 0.025 micron; breadth, 0.021; breadth of isthmus, 0.0085.

STAURASTRUM sp. Plate 5, fig. 74.

Cells about 1.5 broad as long, constriction deep. Semicells cup-shaped, upper angles of the cell produced to long processes, projecting horizontally. Cell wall granulate with a circle of long spines around the base of the semicells. Vertical view 3-angled. Length, 0.02 micron; breadth, 0.032.

SPONDYLOSIUM PAPILLOSUM West and G. S. West. Plate 5, fig. 72.

Cells small, united to form twisted filaments, destitute of a gelatinous sheath. Cells slightly longer than broad. Semicells elliptic with truncate apices. Length, 0.0085 micron; breadth, 0.01; breadth of isthmus, 0.005.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Cylindrocystis brebissonii* Menegh. var. *minor* West and G. S. West.
2. *Gonatozygon kinahani* (Arch.) Rabenh.
3. *Netrium nagelii* (Bréb.) West.
4. *Penium libellula* (Focke) Nordst.
5. *Penium margaritaceum* (Ehrenb.) Bréb.
6. *Pleurotaenium trabecula* (Ehrenb.) Näg.
7. *Pleurotaenium trabecula* (Ehrenb.) Näg. forma *clavata* (Kütz.) West and G. S. West.
8. *Pleurotaenium* sp.
9. *Closterium turgidum* Ehrenb.
10. *Closterium decorum* Bréb. var. *minor* var. nov.

PLATE 2

FIG. 11. *Closterium intermedium* Ralfs.
12. *Closterium striolatum* Ehrenb.
13. *Closterium tumidum* Jahnson var. *koreana* var. nov.
14. *Micrasterias decemdentata* Näg.
15. *Closterium moniliferum* (Bory) Ehrenb.
16. *Closterium moniliferum* (Bory) Ehrenb.
17. *Closterium leibleinii* Kütz. var. *boergesenii* Schmidle.
18. *Closterium parvulum* Näg. var. *angustum* West and G. S. West.
19. *Closterium parvulum* Näg. var. *angustum* West and G. S. West.

PLATE 3

FIG. 20. *Euastrum binale* (Turp.) Ehrenb. forma *koreana* forma nov.
21. *Euastrum dubium* Näg. forma *koreana* forma nov.
22. *Euastrum insulare* (Wittr.) Roy.
23. *Euastrum insulare* (Wittr.) Roy forma *minuta* forma nov.
24. *Euastrum insulare* (Wittr.) Roy forma *minuta* forma nov.
25. *Cosmarium obsoletum* (Hantzsch.) Reinsch.
26. *Cosmarium pachydermum* Lund var. *aethiopicum* West and G. S. West.
27. *Cosmarium trilobulatum* Reinsch.
28. *Cosmarium asphaerosporum* Nordst. var. *strigosum* Nordst.
29. *Cosmarium asphaerosporum* Nordst. var. *strigosum* Nordst.
30. *Cosmarium sinostegos* Scharschm. var. *obtusus* Gutw.
31. *Cosmarium minimum* West and G. S. West.
32. *Cosmarium minimum* West and G. S. West.
33. *Cosmarium rectangulare* Grun. var. *koreana* var. nov.
34. *Cosmarium pygmaeum* Arch.
35. *Cosmarium pygmaeum* Arch.
36. *Cosmarium abbreviatum* Rasib.
37. *Cosmarium undulatum* Corda var. *minutum* Wittr.

FIG. 38. *Cosmarium regnesis* Reinsch.
39. *Cosmarium pseudoarctoum* Nordst.
40. *Cosmarium moniliforme* (Turp.) Ralfs forma *panduriformis* Heimerl.
41. *Cosmarium subprotumidum* Nordst. var. *gregorii* (Roy and Biss.) West and G. S. West.
42. *Cosmarium punctulatum* Bréb. var. *granulusculum* (Roy and Biss.) West and G. S. West.
43. *Cosmarium punctulatum* Bréb. var. *subpunctulatum* (Nordst.) Börg.
44. *Cosmarium furcatospermum* West and G. S. West.
45. *Cosmarium furcatospermum* West and G. S. West var. *koreana* var. nov.
46. *Cosmarium furcatospermum* West and G. S. West var. *koreana* var. nov.

PLATE 4

FIG. 47. *Cosmarium turgidum* Bréb. var. *koreana* var. nov.
48. *Cosmarium subturgidum* (Turn.) Schmidle forma *minor* Schmidle.
49. *Cosmarium subturgidum* (Turn.) Schmidle forma *minor* Schmidle.
50. *Cosmarium willei* Turner.
51. *Cosmarium lundellii* Delp. var. *corruptum* (Turn.) West and G. S. West.
52. *Cosmarium geminatum* Lund var. *rotundatum* Lütkemüller.
53. *Cosmarium pseudoprotuberans* Kirchn.
54. *Cosmarium orthostichum* Lund var. *compactum* West and G. S. West.
55. *Cosmarium contractum* Kirchn. forma *jacobsenii* (Roy) West and G. S. West.
56. *Cosmarium vexatum* West.
57. *Cosmarium subtumidum* Nordst.
58. *Cosmarium contractum* Kirchn. forma *jacobsenii* (Roy) West and G. S. West.

PLATE 5

FIG. 59. *Arthrodesmus convergens* Ehrenb.
60. *Xanthidium concinnum* Arch. var. *boldtiana* West.
61. *Arthrodesmus phimus* Turn. var. *koreana* var. nov.
62. *Staurastrum gracile* Ralfs var. *nanum* Wille.
63. *Staurastrum alternans* Bréb.
64. *Staurastrum striolatum* (Näg.) Arch.
65. *Staurastrum muticum* Bréb.
66. *Staurastrum vestitum* Ralfs var. *koreana* var. nov.
67. *Staurastrum granulosum* (Ehrenb.) Ralfs.
68. *Staurastrum paradoxum* Meyen var. *parvum* West.
69. *Staurastrum leptocladum* Nordst. var. *sinuatum* Wolle forma *planum* Smith.
70. *Staurastrum connatum* (Lund) Roy and Biss.
71. *Staurastrum dilatatum* Ehrenb.
72. *Spondylosium papillosum* West and G. S. West.
73. *Staurastrum quadrangulare* Bréb.
74. *Staurastrum* sp.

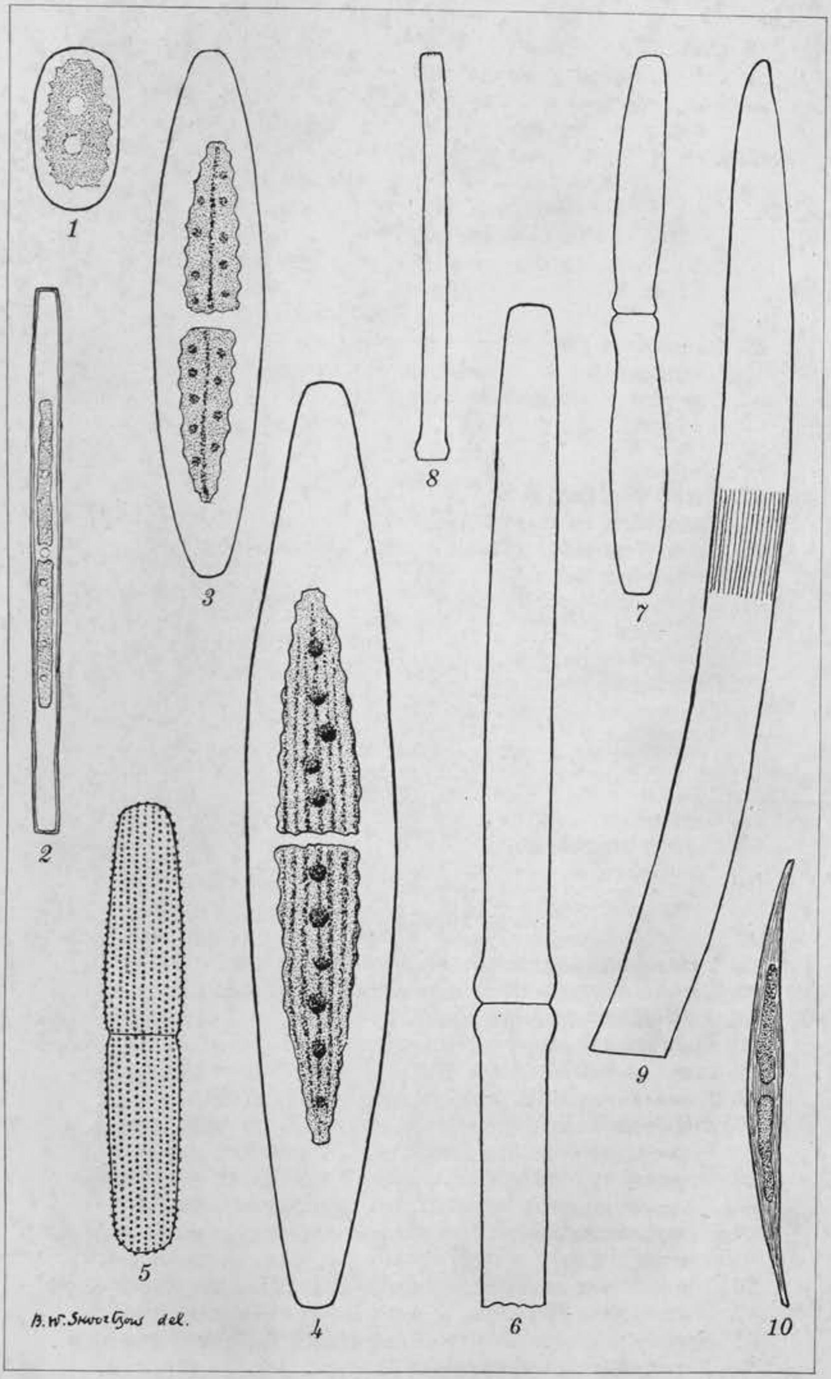

PLATE 1.

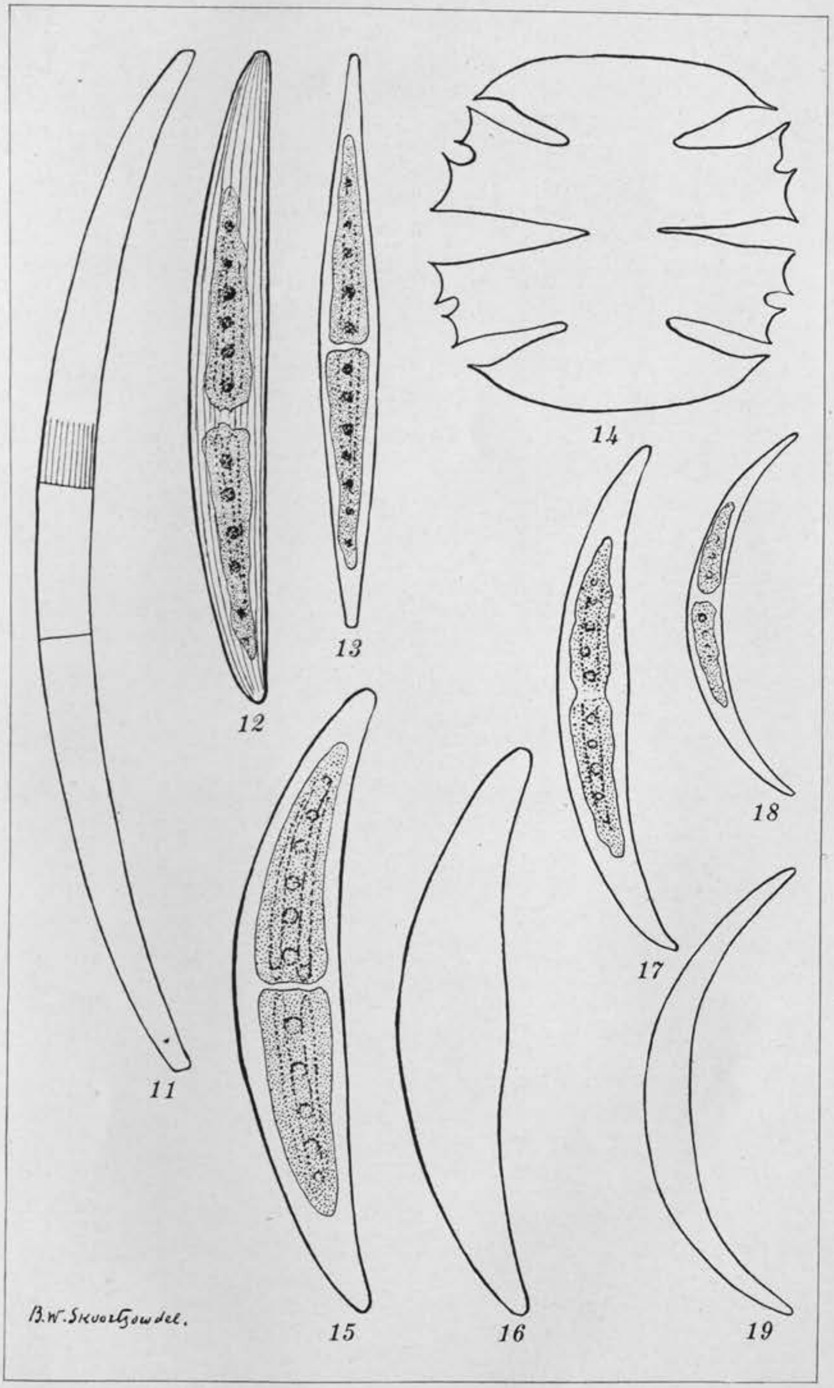

PLATE 2.

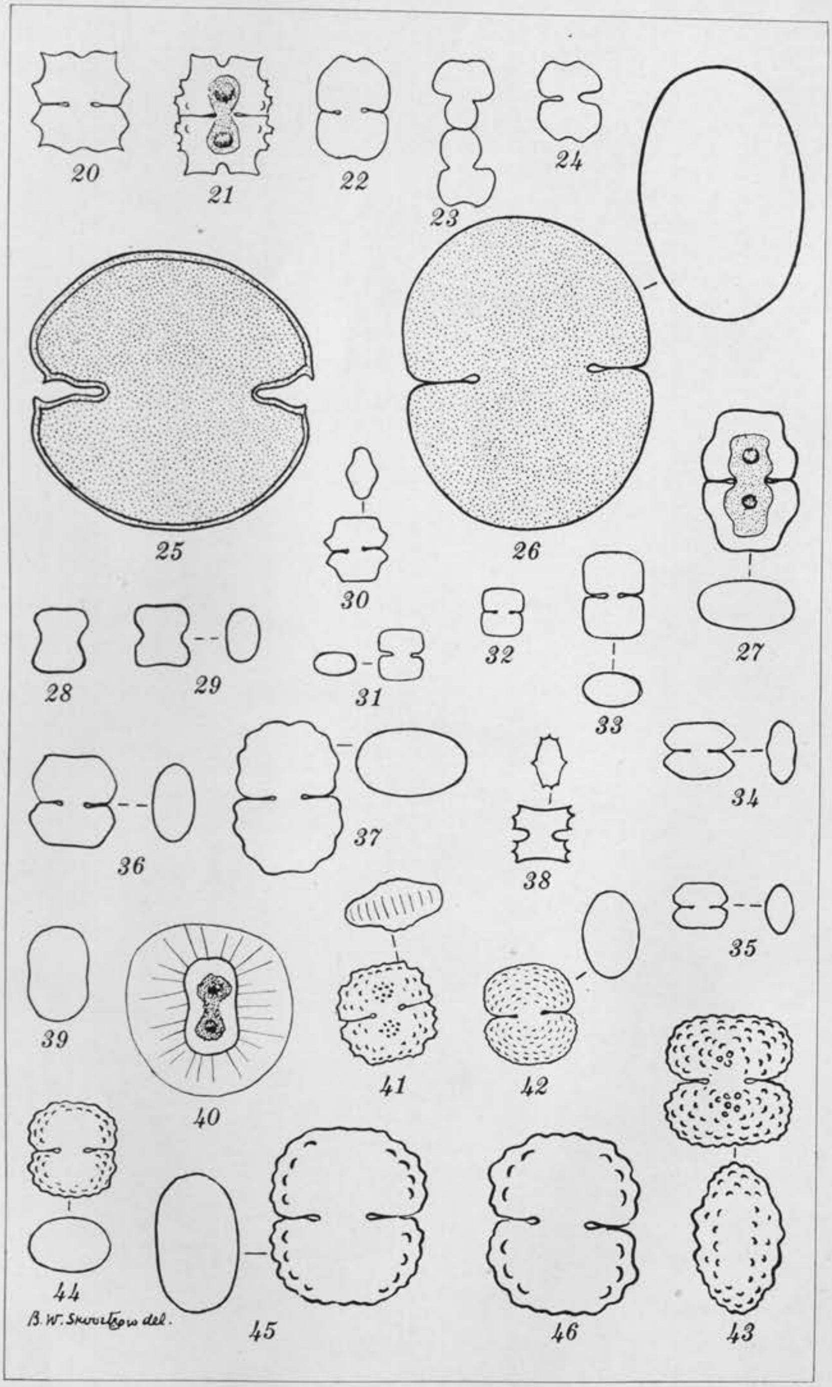
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PLATE 3.

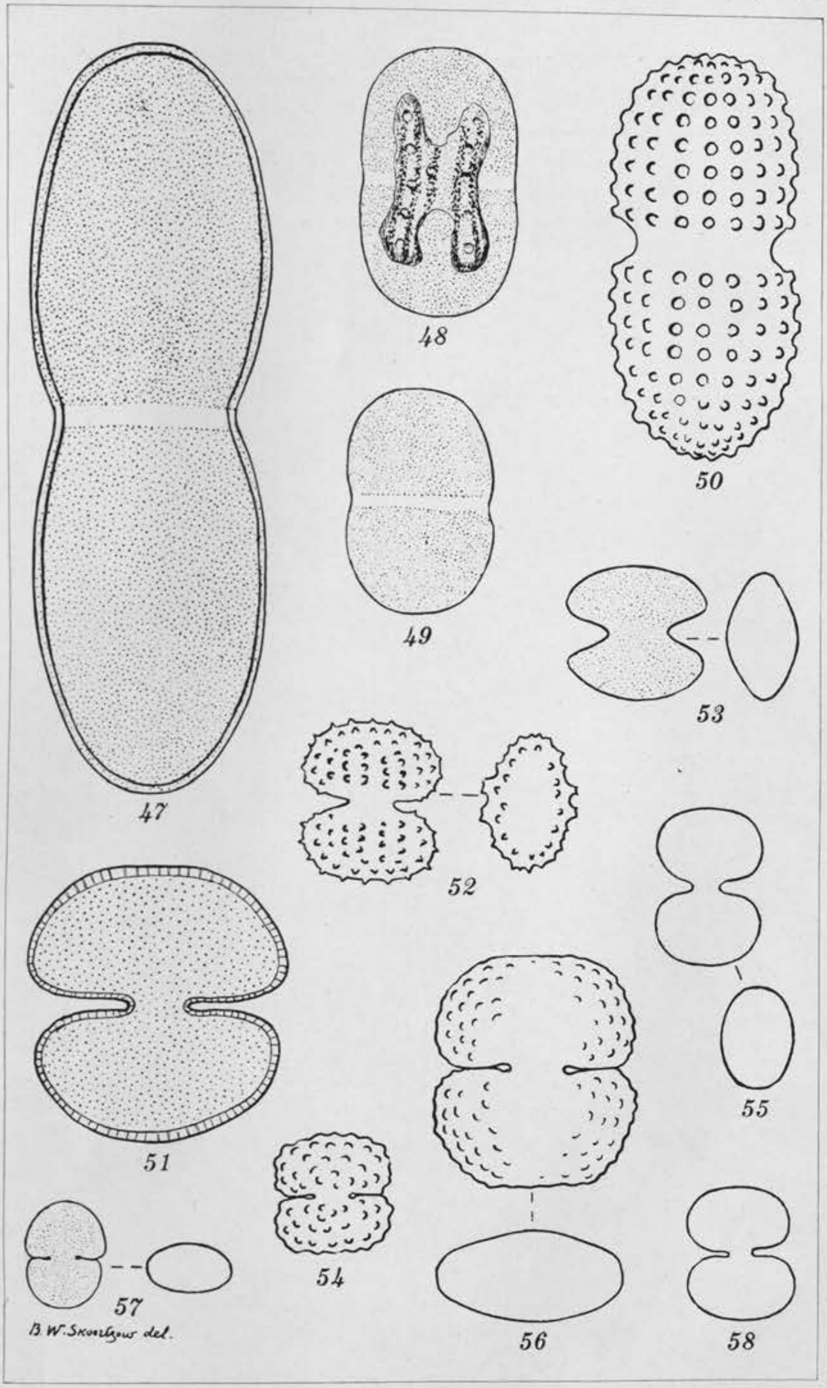

PLATE 4.

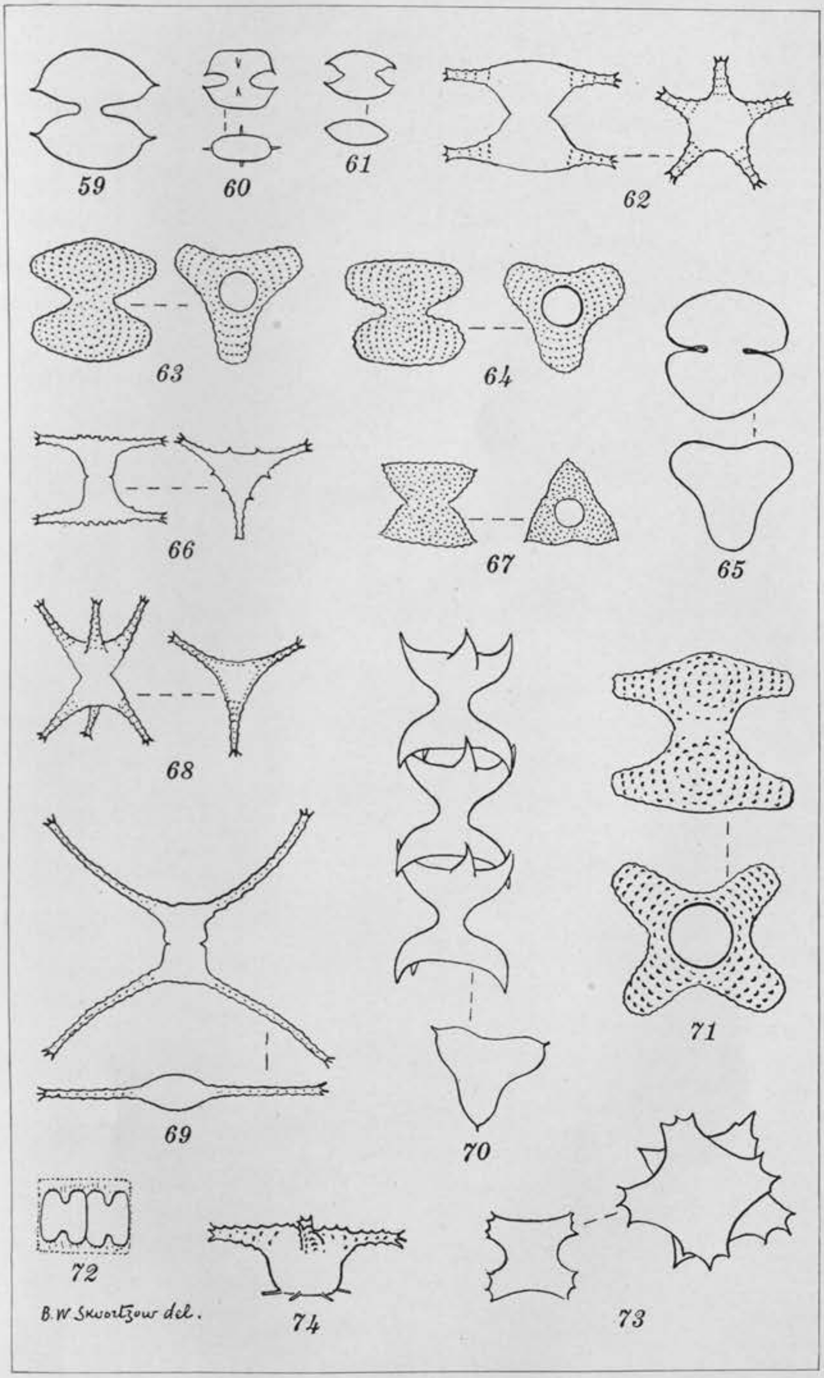

PLATE 5.

STUDIES AND ILLUSTRATIONS IN THE POLYPORACEÆ, III

SUPPLEMENTARY NOTES ON THE GANODERMA APPLANATUM GROUP

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TWELVE PLATES

Since our preliminary paper[1] on this group was published we have had, through the courtesy of the Kew Herbarium and the Paris Museum of Natural History, the privilege of examining several of the older specimens or types, pertaining to the *applanatum* assemblage, concerning which we had expressed tentative opinions. Among the noteworthy specimens loaned by the Kew Herbarium were a fragment from the only authentic specimen of *Polyporus australis* Fries, a small segment from a large specimen which Miss Wakefield found agrees with the Friesian specimen as to spores, two small portions of an English specimen determined by Rea as *G. australe* (Fries), and the two collections of Elmer's Philippine Plants, *6943* and *7213*, cited by Murrill in his original description of *Ganoderma subtornatum* Murr. From the Paris Museum we received the types of *Polyporus testaceus* Léveillé, *Polyporus mastoporus* Léveillé, *Polyporus leucophaeus* Montagne, and an authentic specimen, or perhaps the type, of *Polyporus tornatus* Pers. collected by Gaudichaud in Rawak Island.

A study of these specimens in no way modifies the opinions expressed in the former paper but, rather, strengthens them. Notes and illustrations of such historic specimens, however, may prove of value to future workers in making interpretations within the group.

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[1] Philip. Journ. Sci. 45 (1931) 483-589.

TECHNIC

The technic followed was the same as in previous work; namely, microscopic measurements of hyphæ and spores were made with a 1/12a fluorite oil-immersion objective and 10x Huyghenian ocular, using a Leitz microscope, with a tube length of 160 millimeters, while colors of these elements were observed with a No. 6 (4-millimeter) objective and the same ocular; the colors being compared with Ridgway's color code. All mounts were made in 7 per cent potassium hydroxide by the methods formerly indicated. Unless otherwise stated ten measurements were made of the various elements. Photomicrographs of the spores were made with oil-immersion objective and 8x ocular.

GANODERMA AUSTRALE (FRIES)

In our previous paper we discussed this species from the standpoint of the literature. In a communication to the senior author Miss Elsie M. Wakefield, of the Kew Herbarium, states that to her knowledge the only Friesian specimen that exists is at Kew, but it is an insect-eaten specimen which has lost its outer crust, hence neither the nature of the crust nor the original thickness of the flesh can be determined. She states, however, that the spores are distinctly larger than in English specimens of *G. applanatum* but that she has an African form which seems to match it in that respect. We have studied both of these specimens, as well as English material determined by Rea, but in as much as the specimens loaned us were rather fragmentary we can only express general opinions concerning them.

The fragment of pores (Plate 5, fig. 1) of the authentic specimen shows nothing distinctive in coloration, being near Natal brown (R)[2] with continuous open tubes which average four to a millimeter. The orifices are pale brownish, almost circular, the walls appearing thick, equaling or exceeding the diameter of the tubes, even, and entire. The longisection, however, shows them much thinner walled within. The structure shows nothing distinctive, the dissepiments being made up of more or less interwoven hyphæ with a tendency to a longitudinal arrangement; the hyphæ varying in color from deep olive-buff, to dark olive-buff, the size ranging from 2.1 to 7.1 μ, with an average of 4.1 μ. A crushed mount gives pale spores (Plate

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[2] Ridgway, Robert, Color Standards and Color Nomenclature. Washington (1912).

12, fig. 1), which are near olive-buff, with rather fine but very distinct striæ, ranging in size from 7.3 to 8 μ by 10.6 to 12 μ, with an average of 7.7 by 11.1 μ. Dissepiment hyphæ (Plate 8, fig. 1; Plate 9, fig. 4) vary from 2.1 to 7.1 μ, with an average of 4.1 μ and vary in color from deep olive-buff to dark olive-buff.

Discussion.—The pores average somewhat larger, as expressed in number per millimeter, than in any of the species or varieties described in the earlier paper. In crushed mount the spores are more uniformly pale than in most of the collections so far examined in the *applanatum* group; they exceed all in maximum length and all but *lobatum* and *applanatum* var. *brownii* in maximum width, falling within the range for the latter. In average size they exceed all measurements so far made on *applanatum* and likewise fall within *applanatum* var. *brownii.*

From the data at hand it would appear that we are not dealing with a member of the *Ganoderma applanatum* group as discussed in our earlier paper. In *Ganoderma applanatum* var. *brownii,* although the spores are approximately the same size, they are, except in young specimens, considerably darker and more coarsely striate, which fact would make reference of *australe* to that variety rather doubtful. There can be no question about its being distinct from *Ganoderma tornatum* (Pers.).

The next specimen is a small segment (Plate 1, figs. 1 to 3) sent by Miss Wakefield, labelled "portion of a large specimen which seems to match Fries' as to spores, but has not specially thin flesh. Older specimens sent under the same number are less laccate and have a dull crust like applanatum, etc." The specimen is apparently the one stated in her letter as coming from Africa.

This marginal segment is 6.5 centimeters long, 2.7 centimeters thick at the base, applanate, broadly rounded above. Upper surface with three rather deep sulci, the ridges tuberculose except near the margin, near Natal brown (R), now dull, blackish where rubbed, apparently laccate when fresh, with a somewhat paler margin which is sterile beneath for 5 millimeters, dusted with cinnamon spores, glabrous behind but with minute pubescence at the margin. Crust indistinct, brown, not over 0.1 millimeter thick, lacking at the extreme margin, easily indented, finely but abundantly cracked, minutely wrinkled. Context 1.4 centimeters thick at the base, soft, spongy, felted, the fibers horizontal below but curving upward to the crust in the upper layer, with none of the harder streaks common in the *applanatum* group, narrowly but distinctly concentrically zoned, uniformly auburn (R) except for a slightly darker zone bordering the pores and a narrow lighter band just under the crust, this being pale tawny and less than 0.33 millimeter thick. Pores approaching brownish drab (R) but somewhat darker, in a single layer up to 1.5 centimeters thick, lined with loose hyphæ but not stuffed, usually four to the millimeter, with thin to medium thin dissepiments. Lower surface flavous, brownish tinged where bruised, with the pore orifices circular to subangular and the dissepiments of medium thickness, entire.

There is nothing distinctive in the structure (Plate 5, fig. 5). The dissepiment hyphæ (Plate 8, fig. 2; Plate 9, fig. 5) range in color from deep olive-buff to old gold and vary from 2.1 to 5.6 μ, with an average of 3.8 μ. The context hyphæ vary from old gold to a shade between honey yellow and Isabella color and range from 2.1 to 8.5 μ, with an average of 4.5 μ. The spores (Plate 12, fig. 2) from the upper surface range from 7.1 to 8.2 by 10.6 to 12.7 μ with an average of 7.4 by 11.4 μ, and vary from deep olive-buff to dark olive with moderately fine, distinct striæ. A radial section of the crust (Plate 6, fig. 5) shows a distinct palisade arrangement.

Discussion.—In comparison with the preceding specimen there are only slight differences as far as the elements are represented. The pores are flavous, whereas in the authentic specimen they are pale brown, but such variations often occur in various species. In the authentic specimen none of the darker spores are present and the striæ are somewhat finer. The spores, however, are essentially the same in size and only differ in these minor characters. It should be noted, however, that in the authentic specimen they were measured from a crushed mount of the pores while in the other they came from the upper surface and were, therefore, probably more mature. The darker dissepiment hyphæ tend more to dark olive-buff in the authentic specimen than to the more yellowish shade represented by the old gold of the African specimen. The lighter hyphæ are about the same color in both specimens.

The context is of the same dark color and consistency as in *Ganoderma sulcatum* Murr., but the spores differ much in character from that species. We have seen nothing to match it. It certainly does not belong in the *Ganoderma applanatum* assemblage, for in that group the crust does not show palisade structure, as it does in this one.

The third specimen from Kew, collected and determined by Rea, consists of a slice (Plate 1, figs. 4 and 5) of a lightweight fungus, which has become contracted and distorted in drying. The plant is rounded above, with a thin decurved margin, 8 centimeters long, 2.5 centimeters thick behind. The posterior portion of the upper surface is nearly black, with a suggestion of dark reddish, the anterior portion being dark reddish (approaching Ridgway's dark purple-drab), shining laccate behind, dull in front, deeply wrinkled in both directions but to a larger extent longitudinally. Margin black, sterile for 1 millimeter below. Context firm, almost woody, up to 7 millimeters thick behind, gradually tapering to the acute margin, longitudinally fibrous, cinnamon-brown (R) with a narrow cinnamon-buff (R) zone just beneath the crust; none of the harder streaks present. Lower surface medium brown, somewhat blackish discolored. Pores up to 2 centimeters long behind, becoming less than 1 millimeter at the margin, continuous, not layered, approaching snuff brown (R) in longisection, four, occasionally five, to a millimeter; dissepiments medium thick (Plate 5, fig. 3), somewhat eroded; orifices subangular to angular, somewhat occluded by an overgrowth of mold. Dissepiment hyphæ (Plate 8, fig. 3; Plate 9, fig. 6) near old gold, 2.1 to 5.9 μ, with an average of 3.7 μ. Context hyphæ vary from deep olive-buff to near old gold, 2.5 to 8.5 μ, averaging 4.5 μ. Spores (Plate 12, fig. 3) vary from olive-buff to deep olive-buff, with fine striæ, 6.3 to 7.8 by 8.7 to 11.3 μ, with an average of 7 by 10.3 μ. Crust (Plate 6, fig. 6) composed of long cylindric palisade cells.

Discussion.—While the writers have seen no authenticated specimens of *Ganoderma resinaceum* Boudier, it would appear from the descriptions available that the fungus may be closely related to that species or, perhaps, only a variant of it. It is also close to *Ganoderma sessile* Murr., although it differs from it considerably more in the context than is usual for that species. The spores, however, are essentially the same.

Fries's original description of *Polyporus australis*[3] calls for a plant with a very hard, dimidiate, plano-convex, pileus which is tuberculose-sulcate, glabrous, and blackish spadiceous above, with small pallid pores, umbrinous within, orifices whitish at first. He also stresses a broad, sterile, laccate margin on the underside and a thin context, and says that as the fungus ages the younger layers [of pores] become more and reduced, in consequence of which the older the fungus the wider the sterile margin and the narrower the hymenium [pore surface].

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[3] Elenchus 1 (1828) 108.

Although we have not seen any specimens of the *applanatum* group with a laccate margin this other condition is occasionally met with in specimens having thick vertically receding margins. In such instances the last pore surface is much smaller in area than the first layer laid down. Fries's original description would therefore fit what we consider variety *tornatum* Pers., with the exception of the laccate, sterile lower margin. In this description he only reports the fungus from islands of the Pacific Ocean, but later [4] he records it also throughout the Southern Hemisphere, with particular mention of Chile, and states that *Polyporus tornatus* Pers. is the same species. A still later description [5] is essentially the same as the preceding one, but with the addition "also noted in southern Europe, in Italy (de Notaris), and in lower Austria (Heufler)."

It thus appears that Fries departed considerably in his later work from his original concept of the species. It also appears that he may have confused two species in the original description, for a hard fungus of the character of *tornatum* would be a distinct novelty if provided with a laccate margin.

It is, therefore, doubtful whether the identity of the original *Ganoderma australe* (Fries) will ever be satisfactorily established. Most concepts and descriptions apply to a variant within the *applanatum* group. Fries himself considered it the same as Persoon's *Ganoderma tornatum*, which we have placed as a variety of *Ganoderma applanatum*. The fragments of the authentic specimen that we have just discussed, however, could not be referred there, for it has entirely different spores. It would appear best, therefore, to discontinue use of the name.

GANODERMA TORNATUM (PERS.)

The authentic specimen at hand from the Paris Museum bears the original label (Plate 1, fig. 8) "*Polyporus tornatus* v. *B. applanatus*. Rawak, Gaudichaud," without date. We have not had access to the original description,[6] but the specimen under consideration appears to be the type. It is small, 4.5 centimeters wide, 3.2 centimeters long, with a basal thickness of 0.9 centimeter (Plate 1, figs. 6 and 7). Upper surface (Plate 7, fig. 1) near chestnut-brown (R), somewhat blackened in spots from rubbing, glabrous or very nearly so, shallowly concentric sulcate. Margin subacute, concolorous. Lower surface nearly concolorous with the upper, with a narrow sterile blackened margin and blackened areas over the pore surface, particularly at the periphery. Pores (Plate 5, fig. 6; Plate 11, fig. 1) in a single layer, near dark vinaceous-drab in longisection, circular to subangular, 4.5 to 5 to a millimeter, up to 6 millimeters long behind, usually moderately thin walled but thick walled in certain areas; dissepiments entire. Context fibrous, up to 3.5 millimeters thick behind, varying from near Mikado brown (R) above to chestnut (R) below, obscurely concentrically zoned. The hard black streaks characteristic of the species were only noted at the extreme posterior portion, since the context was only exposed in a plane nearly paralleling the area of attachment. In crushed mount the spores (Plate 12, fig. 4) vary from olive-buff (R) to dark olive-buff (R), with coarse distinct striæ. They range from 4.9 to 5.6 by 6.8 to 7.8 μ, with an average of 5.3 by 7.1 μ. Both dissepiment hyphæ (Plate 8, fig. 4; Plate 9, fig. 7) and context hyphæ vary from deep olive-buff to old gold and show an average diameter of 4.2 μ, the former ranging from 2.1 to 7.8 μ, and the latter from 2.1 to 8.5 μ. Moderately thin-walled and thick-walled hyphæ are intermixed.

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[4] Epicrisis (1836–38) 464.

[5] Hymenomycetes Europaei (1874) 556.

[6] Gaudichaud-Beaupré, Charles, Botanique du voyage autour de monde par ordre du roi sui les corvettes l'Uranie et la Physcienne pendant les années 1817–1820 par M. Louis de Freycinet. Paris (1826) 173.

Discussion.—Although small and of only a single season's growth the specimen can readily be matched with many others recorded under variety *tornatum* in the previous paper. The spores average a little smaller than usual, but this can readily be accounted for by the two factors just mentioned.

A specimen of variety *tornatum* was sent us by the Paris Museum with the data "*Fomes australis* Fr., Brésil, Environs de Rio de Janeiro." The packet contains also a specimen of *Fomes marmoratus* Berk. The *tornatum* specimen (Plate 1, figs. 9 to 11) throws further light on that variety in the American Tropics, for variety *tornatum* is predominantly an inhabitant of the Eastern Hemisphere. The senior author has eight collections of the *applanatum* group from Brazil, six of which were placed in *applanatum* in the former paper, but none of them were referable to variety *tornatum*. The specimen that we here consider variety *tornatum* is quite close to Oriental material in general appearance, although the spores are not so coarsely striate. They are smaller, however, than in all other

Brazilian specimens so far examined and readily fall within the range of the variety.

The upper surface is broadly convex, lightly concentric sulcate, glabrous, Verona brown (R), dusted with spores, with a dark brown to blackish crust 0.25 to 0.5 millimeter in thickness, somewhat cracked. Context about 8 millimeters thick behind, tapering to 2 millimeters, firm corky, obscurely concentrically zonate, fibrous, with hard black streaks extending to near the margin, somewhat darker than russet (R) with a narrow auburn (R) line next to the pores and suggestions of Sayal brown (R) just under the crust (Plate 7, fig. 2). Lower surface approaching cinnamon-drab (R), benzo brown (R) where bruised, with a 2-millimeter, somewhat raised, sterile margin. Pores in longisection cinnamon-drab (R) in three layers with no sterile tissue between, the longest 6 millimeters, most of them stuffed with a whitish substance, 4.5 to 5 to a millimeter, subangular to angular, with medium, nearly entire dissepiments.

Dissepiment (Plate 8, fig. 5; Plate 9, fig. 8) and context hyphæ near old gold, the former, 2.1 to 5.9 μ, averaging 3.5 μ; the latter, 2.1 to 6.3 μ, with an average of 3.9 μ. Spores from the crushed mount the same as those from the upper surface (Plate 12, fig. 5), which are deep olive-buff to dark olive-buff with moderately fine, distinct striæ, 5.4 to 5.9 by 7.8 to 8.7 μ, with an average of 5.6 by 8.4 μ.

Discussion.—Brazilian specimens offer several problems in varietal segregation, as evidenced by variety *testaceum*. Forms of *applanatum* with thin context, such as we usually have in variety *tornatum*, are well represented, but the general appearance and the spores of these specimens, many of which are even larger than in American and European material of *applanatum*, argue for their placement in the base species.

GANODERMA APPLANATUM (PERS.) PAT.

Two English specimens were received from Miss Wakefield which throw further light on European forms of this species. One of the specimens (Plate 2, figs. 1 to 3) is typically applanate, tuberculose, somewhat paler than wood brown (R) in front and between hair brown (R) and Chaetura drab (R) behind, obscurely zoned and somewhat sulcate. Context bay (R) next to the pores, pale russet above, firm corky, concentrically zoned, with inconspicuous fawn-colored streaks, but no hard black ones. Crust (Plate 7, fig. 4) brown, 0.66 millimeter thick, and hard behind, thinner in front, where it can be indented with moderate pressure of the thumb nail. Pores in two layers with a layer of sterile bay tissue varying from 0.5 to 4 millimeters thick between, up to 1.5 centimeters long behind, four to five to a millimeter, with moderately thin dissepiments, approaching cinnamon-drab (R) in longisection. Lower surface light grayish olive (R), bruising to near Natal brown (R), with a sterile tumid margin 5 to 7 millimeters wide. Pore orifices circular to subangular, with entire nearly even dissepiments.

Dissepiment (Plate 8, fig. 6; Plate 10, fig. 1) and context hyphæ near old gold, the former ranging from 2.5 to 5.6 μ, averaging 3.7 μ, the latter 2.5 to 7.1 μ, averaging 4.3 μ. Spores (Plate 12, fig. 6) in crushed mount rather small, olive-buff to dark olive-buff with moderately fine striæ, 6.3 to 7.1 by 8.5 to 9.6 μ, averaging 6.7 by 9.1 μ

Discussion.—This specimen is rather close to American material in appearance and structure. The presence of fawn-colored streaks in the context brings it into relationship with variety *philippinense* Humph., where this character is developed to a marked degree. In other respects, however, it is typical *applanatum.* It is interesting to note that the spores are much smaller than certain ones figured in the earlier paper (see Plate 32, fig. 5) from an English specimen. The ones intermixed with these, however, were approximately the same as the ones figured herein.

The second specimen sent was an unusual thick ungulate form (Plate 2, figs. 4 and 5) with essentially the same colorations as the other specimen, first year's growth somewhat tuberculose, near blackish mouse gray (R) above, followed by a second year's growth extending beyond the first and forming a thick rounded tumid margin between avellaneous (R) and wood brown (R), bruising to dark brown. Crust thin, blackish, firm, almost lacking over the second year's growth. Context corky, nearly 7 centimeters thick, near auburn (R), concentrically zoned, lacking radiate hard black streaks but with a hard black line paralleling the upper surface at a depth of 0.8 to 1.5 centimeters. Lower surface rather uneven, approaching olive-buff (R), cinnamon-drab (R) where bruised. Pores in two narrow layers separated by a sterile tissue layer up to 8 millimeters thick, maximum length 5 millimeters, three to four to a millimeter. Dissepiments of medium thickness in longisection, but appearing thick walled when viewed from the lower surface, entire; orifices circular to subangular.

Dissepiment (Plate 8, fig. 7; Plate 10, fig. 2) and pore hyphæ near old gold (R), the former 2.1 to 5.6 μ, averaging 3.6 μ, the latter 2.5 to 5.9 μ, with an average of 4.4 μ. Spores (Plate 12, fig. 7) from the upper surface deep olive-buff to dark olive-buff with moderately rough, distinct striæ, 6.3 to 7.1 by 8.7 to 9.9 μ, averaging 6.7 by 9.3 μ. Crust (Plate 7, fig. 3) not palisade in structure.

Discussion.—This specimen is very abnormal in respect to its ungulate character and approaches *Ganoderma applanatum* var. *brownii* Murr. in gross appearance, having the same character and color of context as younger specimens of that variety. The pores are somewhat larger, however, and the pore surface is lighter in color. The only character that really distinguishes it from the variety is the size of the spores, which in variety *brownii* averages 7.92 by 12.46 μ for those from the upper surface, and 7.6 by 11.62 μ for those in crushed mounts. The striæ in the variety are also usually coarser.

GANODERMA LEUCOPHÆUM (MONT.)

A specimen from the Paris Museum (Plate 1, figs. 12 to 15), labelled "Ganoderma leucophæum (Mont.) Pat., Ohio (Sullivant), ex typo Montagneano," was available for study. This is nearly whole, although somewhat broken away where broadly attached behind, 2.5 centimeters long, 4.5 centimeters wide, 1.5 centimeters thick at the attachment. Upper surface somewhat darker than cartridge buff (R) with obscure pale drab zonation, glabrous to the eye but minutely puberulent under a hand lens, nearly plane, somewhat uneven, with a rounded margin. Crust 0.5 millimeter thick or less, blackish in section. Context (Plate 5, fig. 2) considerably insect eaten, auburn (R) near the crust and approaching Vandyke brown (R) below, firm corky, felted, 7 millimeters thick. Lower surface a little lighter than Prout's brown (R) with a broad sterile, minutely puberulent margin 1 centimeter wide, which is strongly tinged with avellaneous (R). Pores in longisection concolorous with the pore surface, in a single layer, up to 7.5 millimeters long, with rather thick dissepiments, four to five to a millimeter. Orifices (Plate 11, fig. 2) circular to subangular, with walls nearly even, entire.

Dissepiment (Plate 8, fig. 8; Plate 10, fig. 3) and context hyphæ deep olive-buff to near old gold, the former 2.1 to 5.6 μ, averaging 3.5 μ; the latter 2.1 to 7.8 μ, with an average of 3.7 μ. Spores (Plate 12, fig. 8) from the crushed mount deep olive-buff to dark olive-buff, with moderately fine, distinct striæ, 4.9 to 5.9 by 7.1 to 8.5 μ, averaging 5.5 by 7.6 μ. Crust (Plate 7, fig. 5) not palisade.

Discussion.—Although small the plant is typical of much of the American material that is usually placed in *Ganoderma applanatum.* While the spores are somewhat shorter than the average for American specimens this is probably due to the fact that the specimen is young. In our opinion the broad sterile margin and the pale crust are certainly not sufficient for even varietal segregation. It is, therefore, best to place the species as a direct synonym of *Ganoderma applanatum* (Pers.) Pat.

GANODERMA SUBTORNATUM MURRILL

Our discussion of this species in the previous paper[7] led to the opinion that *Ganoderma subtornatum* Murr., would prove synonymous with *Ganoderma mastoporum* Lév. While we have been unable to study the type of *subtornatum,* we have had the opportunity of examining the two Elmer collections cited in the original description. These two collections vary widely in appearance, but when one studies a large series of *mastoporum,* as we have done, it would appear that they must be considered merely variants of it.

Elmer 7213, Palo, Leyte Island, Philippines, January, 1906, in the Kew Herbarium, consists of a single applanate specimen (Plate 2, figs. 6 to 8) formed of two closely coalescent pilei, 5.2 centimeters long, 13 centimeters wide, and 2.3 centimeters thick at the base. Upper surface broadly convex, strongly sulcate, slightly radiate ridged, with a subacute margin, dull laccate, glabrous, near dark purplish gray (R) except where covered with a wood brown (R) scurf, with a small umbo behind. Context auburn (R) next to the pores, shading into cinnamon (R) near the crust, with small whitish bleached areas tinged with pale buff, 1.5 centimeters thick at the umbo, then reducing to 7 millimeters, whence it gradually tapers to 2 millimeters at the edge, fibrous, corky, obscurely concentrically zoned, with harder black streaks extending from the base to over one-half the length. Crust (Plate 6, fig. 2) thin, blackish in section, 0.12 to 0.20 millimeter, moderately hard to indent with the thumb nail, extending over the margin to the pores. Lower surface slightly concave, nearly even, near dark vinaceous-drab (R) with a sharply delimited, somewhat raised, sterile band, 3 to 5 millimeters wide at the margin; also bordered by a blackish sterile band next to the wood. Pores (Plate 6, fig. 1) in longisection a little lighter than Natal brown (R), five to six to a millimeter, up to 8 millimeters long, with medium, entire, dissepiments. Orifices (Plate 11, fig. 5) circular to subangular, often arranged in more or less sinuous rows with the portion of the wall which is at right angles to the sinuous ridges somewhat depressed, giving the appearance of the pores being set in shallow valleys one pore in width.

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[7] Philip. Journ. Sci. 45 (1931) 504–506.

Dissepiment hyphæ (Plate 9, fig. 2; Plate 10, fig. 5) vary from deep olive-buff (R) to dark olive-buff, 2.1 to 6.3 μ in diameter, averaging 3.9 μ. Context hyphæ are near old gold, 2.1 to 8.5 μ and average 4.5 μ. Spores (Plate 12, fig. 11) are near deep olive-buff with moderately coarse, distinct striæ, 5.6 to 5.9 by 8.5 to 9.6 μ, averaging 5.7 by 9.0 μ.

Discussion.—This specimen can readily be matched with other Philippine collections and is fairly representative of *Ganoderma mastoporum* in the Islands. The type of *mastoporum* has now lost almost all of its context through insect attack, but what little remains is exactly the same in color and character as in *subtornatum.* The upper surface, however, is now dull and obscurely banded with smoke gray (R) and benzo brown (R) but the short stipe is blackened with the same dull blackish laccation as *subtornatum.* The principal difference lies in the character of the pore mouths, which are distinctly mammillate over most of the surface in *mastoporum;* toward one side, however, they tend to form in linear valleys as in *subtornatum.* This latter is the common condition in Philippine specimens, but it is not a specific character, since certain specimens in the *applanatum* group have a similar, though less-marked, pore formation.

The other collection, *Elmer 6943,* Mount Mariveles, Bataan Province, Luzon, November, 1904, is a small, nearly circular plant (Plate 3, figs. 1 to 3), 3 centimeters across, 1.5 centimeters thick, broadly attached at the vertex. Upper surface broadly convex, lightly sulcate, slightly radiate ridged, minutely tomentose, lightly dusted with spores, near snuff brown (R). Margin abrupt, nearly vertical for 5 millimeters, vertically ridged to a slight degree. Context corky, felted, about 7 millimeters thick at point of attachment, tapering to 1 millimeter at the margin, Verona brown (R) next to the pores, somewhat lighter above. Lower surface near Mars brown (R), slightly convex, with the vertical margin entirely circumscribing the pores. Pores (Plate 6, fig. 3) in longisection near cinnamon-drab (R), five to a millimeter, with the orifices (Plate 11, fig. 4) somewhat smaller than in *7213* but of the same general character. Some are obscurely mammillate, others have a linear arrangement in valleys, as in the other, but less distinct.

Dissepiment hyphæ (Plate 9, fig. 3; Plate 10, fig. 6) are near old gold, 2.1 to 7.1 μ, averaging 4.1 μ. Context hyphæ vary from dark olive-buff to near old gold, 2.5 to 8.5 μ, with an average of 4.5 μ. Spores from deep olive-buff to dark olive-buff with moderately coarse, distinct striæ. Those from crushed mounts (Plate 12, fig. 12) are the same as those from the upper surface (Plate 12, fig. 13), which measure 5.6 to 6.3 by 9.2 to 9.9 μ, averaging 5.9 by 9.6 μ. Crust (Plate 6, fig. 4) nonpalisade.

Discussion.—The specimen is a fairly close match for another Philippine collection from Todaya (2,800 feet), Davao Province, Mindanao, *E. B. Copeland 1223*, April, 1904, determined *Ganoderma mastoporum* by Lloyd. This specimen has a dorsally attached stipe, but otherwise they are very similar. The form is very unusual, however. In coloration, context, pores, and structure the two Elmer collections cited are very close and merely represent two forms of *mastoporum.* Elmer has distributed a number of other collections as *Ganoderma subtornatum,* however, which are referable to the *applanatum* group, principally *Ganoderma applanatum* var. *philippinense.* There is one collection on the Kew sheets, *Elmer 10756,* which is referable to *Ganoderma applanatum* var. *tornatum* forma *macrospora.* Bresadola erred in practically all of his determinations, for his namings for the Bureau of Science are largely *applanatum* var. *philippinense.*

GANODERMA TESTACEUM (LÉV.)

The type of this species in the Paris Museum bears the label "*Polyporus testaceus* Lév., *Brasilium Meridion.*, Dupré 1842" (Plate 3, fig. 14), and consists of four small specimens attached to a card. One of the specimens (Plate 3, figs. 4 and 5) represents the form stressed in the original description; namely, "in stipitem brevem crassum concolorem producto," but two are merely contracted to a narrow attachment (Plate 3, figs. 6 to 9). The stipe in the typical form is somewhat tuberculose, 2 centimeters long, 1.5 centimeters thick, 1.2 centimeters wide, depressed below the level of the pileus, and consists of an abrupt elongation of it. The same description, with the exception of the more-elongate stipe, applies to three of the specimens, with the exception that the two smaller nonstipitate forms are somewhat less tuberculose than the typical form. The stipitate form is 5.5 centimeters long, 4.3 centimeters wide, and 1.5 centimeters thick at the middle, the two nonstipitate specimens approximately 3 by 2.7 by 1.3 centimeters. The upper surface is convex, moderately to strikingly tuberculose, concentrically sulcate, dull, somewhat dusted with spores, somewhat lighter than snuff brown (R), blackened where rubbed, glabrous or very nearly so. Margin rounded to vertical, sulcate. Context fibrous felted, from Sayal brown (R) above to auburn (R) below, with a few inconspicuous harder blackish streaks extending about two-thirds the length, 6 millimeters thick behind, tapering and continuing the full length of the vertical margin as well as completely circumscribing the pores at the attachment of the pileus. Crust up to 0.4 millimeter thick, hard and blackish in section. Lower surface plane to slightly concave, varying from a little paler than wood brown (R) to snuff brown (R); blackish where bruised. Pores (Plate 5, fig. 4) in longisection completely circumscribed by the sterile margin, approaching benzo brown (R), up to 1 centimeter long, in a single layer, four to five to a millimeter. Dissepiments medium to thick, with even, entire edges. Orifices (Plate 11, fig. 3) circular to subcircular, occasionally subangular.

Both dissepiment (Plate 9, fig. 1; Plate 10, fig. 4) and context hyphæ vary from deep olive-buff to dark olive-buff, the former 2.1 to 5.6 μ, averaging 3.5 μ, the latter 2.1 to 9.2 μ, with an average of 4.4 μ. Spores from the crushed mount are near deep olive-buff, with moderately fine, distinct striæ, 5.4 to 5.9 by 7.8 to 9.2 μ, averaging 5.6 by 8.6 μ. Those on the upper surface (Plate 12, fig. 9) approach Sayal brown (R); under the microscope they appear the same as those from the crushed mount but a little larger, 5.6 to 6.3 by 8.5 to 9.6 μ, averaging 6.0 by 8.9 μ. Crust (Plate 7, fig. 6) nonpalisade in structure.

The fourth linguiform specimen (Plate 3, figs. 11 to 13) included in the type is a young, rather abnormal sporophore of *Fomes marmoratus* Berk., which is now considered a synonym of *Fomes fasciatus* (Sw.). It is very different in several features from the other specimens.

In our previous paper[8] we refer to two collections (Humphrey herbarium *11056*, *11059*), sent to the senior author from Brazil, that agree sufficiently well with the type to be referred to *testaceum*.

No. *11059* (Nova Petropolis, *J. Rick*, 1923) consists of six specimens (Plate 3, figs. 15 to 18), of which one is short stipitate and 1 centimeter thick, one is 1.2 centimeters thick and attached obliquely at the vertex. The other specimens are thin, two being contracted at the attachment, and ranging from 0.7 to 1.2 centimeters thick, while one forms a resupinate plaque 1 centimeter thick, broadly attached at the back; still another is resupinate and broadly attached and is about 7 millimeters thick, with the upper edge reflexed for 1.5 centimeters. The stipitate specimen has a broadly rounded margin, which is sulcate and almost vertical. In the others it is thin to moderately so. All specimens are sulcate, glabrous to minutely puberulent, the color lying between avellaneous (R) and wood brown (R), being somewhat lighter than in the type. The ultimate margin may be pallid or concolorous. The context is 1.5 millimeters thick in the smallest applanate specimen, 5 millimeters in the stipitate one, and matches that of the type almost exactly, although the concentric zonation is somewhat more distinct. The pores in longisection also match the type in size and color, but the orifices are occluded in most of the specimens. In the specimen attached at the vertex there appear to be two layers, very indistinctly separated. Under surface a very pallid brownish (not in Ridgway) bruising to fawn color (R), Natal brown (R), or darker.

Dissepiment and context hyphæ are near old gold, the former 2.2 to 5.2 μ, averaging 3.9 μ, the latter 2.2 to 6.0 μ, averaging 4.1 μ. Spores from the crushed mount olive-buff to deep olive-buff, with moderately fine, distinct striæ, 4.5 to 5.2 by 7.5 to 9 μ, averaging 4.8 by 8.7 μ.

No. *11056* (Parecy, *J. Rick*, 1924) is represented by three specimens, one of which is small, elongate and immature, one 5 by 2.5 by 1 centimeter, with a short stipe 7 millimeters long arising from the middle of the back at the rear, the other 7 by 3.2 by 1.5 centimeters, spathulate (Plate 3, figs. 19 and 20), gradually tapering into a down-curved stem 7 millimeters in diameter.

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[8] Op. cit. 527, pl. 4, figs. 1, 3, 8, 9.

Upper surface nearly plane to distinctly convex, strongly sulcate, the larger specimen a pallid, weathered, grayish color, the other near Sayal brown (R). Context as in the type but distinctly zoned, up to 7 millimeters thick behind. Pores as in the type, up to 8 millimeters long, in a single layer, blackish discolored on the lower surface.

Dissepiment and context hyphæ near olive lake, the former 2.2 to 6.0 μ, averaging 3.7 μ, the latter 2.2 to 6.0 μ, with an average of 4.0 μ. Spores from the crushed mount near deep olive-buff, with rather fine, distinct striæ, 5.2 to 6.7 by 7.5 to 10.4 μ, averaging 5.6 by 8.3 μ.

Discussion.—We are here dealing with a form variant of *Ganoderma applanatum* that it is impossible to segregate on any structural features. It appears characteristic, however, on account of its small size and the peculiar prolongation of some of the specimens into a short stem, and these are about the only descriptive characters by which it can be separated from its Brazilian congeners. While we do not ordinarily believe that form and size alone are worthy of even varietal rank, we are constrained to consider this a variety, which, however, should be interpreted to conform very closely to the type. Much confusion will result if we attempt to broaden the concept, since we might then be running into certain other Brazilian forms of the base species. Of the Brazilian specimens so far examined the *testaceum* forms have smaller spores, usually with finer striæ, but whether this distinction can be maintained after study of a much larger series remains for future investigations to determine.

In accordance with our present opinion we would call the fungus *Ganoderma applanatum* (Pers.) Pat. var. *testaceum* Lév.

We have seen the fungus only from Brazil, and it is probable that many of the specimens from other regions so determined are not strictly referable to it. The several determinations we have seen from the Philippines, although sometimes approaching the variety in form, have somewhat different spores. In our former paper on the *applanatum* group we established *Ganoderma applanatum* var. *tornatum* forma *macrospora.* While this is distinguishable from variety *tornatum* only by its larger *mastoporum* type of spore it has small, often young, forms, stipitate or sessile, usually of lighter weight that parallel similar young stipitate or sessile forms of variety *tornatum,* which are found closely associated with the larger, harder typical forms. It is reasonable then to refer those *testaceum*-like forms with *mastoporum*-like spores to variety *tornatum* forma *macrospora*, and this we prefer to do rather than to broaden the spore concept of *testaceum*.

In order better to convey our idea of the Philippine forms just mentioned we present illustrations and notes on three collections.

No. *50091* (Mount Banahao, Laguna Province, Luzon, *R. C. McGregor,* January 25, 1930) contains several nonlaccate, lightweight specimens (Plate 4, figs. 1 to 12), three of which have stipes, these stipitate forms ranging from 0.5 to 4.5 centimeters long and from 0.5 to 1 centimeter wide. A very young sterile specimen is nearly cylindrical, 2.5 centimeters long, 3 millimeters in diameter. Other specimens are small, contracted at the attachment, or with a slight to distinct umbo behind. The upper surface is somewhat lighter in color and less tuberculose than in the type of *testaceum* but is very close in these respects to *11059* just discussed. The lower surface varies from pallid to dark brown and offers nothing distinctive. While usually rather thick walled, in one specimen the pore walls become quite thin, the orifices being larger, but the number per millimeter remaining the same. The principal variations lie in the darker color of the context, which is near bay (R), and in the spores, which are indistinguishable from those of *mastoporum*.

The dissepiment hyphæ are near dark olive-buff, 2.3 to 5.3 μ, averaging 3.5 μ. The context hyphæ appear between old gold and buffy citrine, 2.3 to 6.0 μ, averaging 3.7 μ. Spores from the upper surface (Plate 12, fig. 10) are between deep olive-buff and dark olive-buff, 6.0 to 6.8 by 9.0 to 9.8 μ, with an average of 6.2 by 9.4 μ, with rather coarse, very distinct striæ. Young spores without striæ are found in crushed mounts intermixed with typical mature ones.

A collection loaned by the Buitenzorg Botanical Garden (*7114*, Batang Paloepoeh, west coast of Sumatra, *E. Jacobson,* July, 1924) closely matches the above Philippine material.

No. *50090* (Ube, Laguna Province, Luzon, *R. C. McGregor,* June 6, 1929) consists of two young sessile, applanate specimens (Plate 4, figs. 13 to 17), one of which is normally attached, the other attached at the center of the back. These are practically the same in form and external coloration as the thin applanate specimens of *11059* from Brazil, but differ in the context being darker and the spores being of the *mastoporum* type. They agree in all respects with an applanate specimen of *50091.*

No. *25107* (Mount Banahao, Laguna Province, Luzon, *H. S. Yates*, October, 1915)[9] was determined by Sydow as *Ganoderma testaceum*. The specimen consists of a thin spathulate sporophore, 6.3 centimeters long, about 5 centimeters wide, 1.3 centimeters thick at the base, contracted to a very small attachment and broadly umbonate behind. Upper surface plano-convex, avellaneous (R) to wood brown (R), zoned with somewhat darker bands, minutely puberulent, obscurely sulcate and slightly radiate ridged. Margin acute, sterile beneath for 1.5 millimeters. Context near auburn (R), firm corky, 6 millimeters thick at the umbo, tapering to 2 millimeters at the tip; with harder black streaks extending nearly to the margin. Lower surface pallid brownish, darker on bruising. Pores up to 7 millimeters long, near Verona brown (R) in longisection, about five to a millimeter, with medium dissepiments. Orifices circular to subcircular, with even, entire edges.

Context hyphæ near old gold, 2.2 to 7.5 μ, averaging 4.7 μ. Spores in crushed mount olive-buff to deep olive-buff, with rather coarse striæ, 4.5 to 6.7 by 7.8 to 9.3 μ, with an average of 5.9 by 8.6 μ.

SUMMARY

The paper offers additional data in support of the taxonomic position taken in our former article on the group. Several authentic specimens or types, together with a number of other variants, were loaned for study by the Kew Herbarium and the Paris Museum. Reports on these are presented.

Ganoderma australe (Fr.). A fragment of the pores of an authentic specimen from Fries in the Kew Herbarium, an African specimen from the same herbarium which is said to match it in spores, and an English specimen so named by Rea were compared. Since the authentic specimen lacked the crust and most of the context, definite conclusions could not be drawn as to its identity. The spores are approximately the same size as in *Ganoderma applanatum* var. *brownii* Murr., but are much paler and more finely striate than in that variety, which has the largest spores known in the *applanatum* group. As far as can be judged from the fragment submitted it differs little from the

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[9] Op. cit. 506.

African specimen, and may be the same species. If this be the case it cannot belong to the *applanatum* group, for the African material has a crust which is distinctly palisade in structure and is therefore excluded from the group.

The determination of Rea is something else, and the fungus may be *Ganoderma resinaceum* Boud. It is also close to *Ganoderma sessile* Murr. of the United States.

In view of the different interpretations given to *Ganoderma australe,* and the lack of satisfactory authentic material with which to compare, it will probably be best to drop the name.

Ganoderma tornatum (Pers.). An authentic Persoonian specimen, perhaps the type, from the Paris Museum, shows that our previous conception was correct. We refer it is a variety of *Ganoderma applanatum* (Pers.) Pat.

Ganoderma applanatum (Pers.) Pat. Two additional English specimens from the Kew Herbarium were examined. The applanate specimen is very close to North American material. The ungulate specimen approaches *Ganoderma applanatum* var. *brownii* but has much smaller spores.

Ganoderma leucophaeum (Mont.). A portion of Montagne's type confirms the opinion of most mycologists that it is nothing but a condition of *Ganoderma applanatum* with a pale crust. It agrees with much of the North American material and is not worthy of varietal segregation.

Ganoderma subtornatum Murr. An examination of the two Elmer collections from the Philippines cited by Murrill in the original description indicates that they are only forms of *Ganoderma mastoporum* (Lév.).

Ganoderma testaceum (Lév.). The type collection from the Paris Museum contains three specimens of *testaceum* and one specimen of *Fomes marmoratus* Berk. [*Fomes fasciatus* (Sw.)]. The fungus is at best a weak variety of *Ganoderma applanatum* and should be rather strictly interpreted to include only those forms in which the stipe develops as a horizontal prolongation of the pileus. While the spores are smaller than in other Brazilian material of *applanatum* examined, and thus help to segregate the variety in that region, nevertheless, they are quite similar to *applanatum* in other parts of the world. Philippine determinations are better referable to *Ganoderma applanatum* var. *tornatum* forma *macrospora* on account of the somewhat darker context and different type of spores.

ACKNOWLEDGMENT

We acknowledge with deep gratitude the services rendered by Rev. Henry C. Avery, S. J., Ph. D., professor of biology in the Ateneo de Manila, in translating from the Latin a considerable number of Persoonian and Friesian descriptions which have been used in our study.

ERRATA

Corrections to our previous paper, in the Philippine Journal of Science 45 (1931) 483-589.

Page 531. To the end of the first paragraph, records of *Ganoderma applanatum, add* Tawi Tawi Island, Sulu Archipelago, *H. S. Yates 35936.*

Page 535, in the fourth paragraph, *for* lines 2, 3, and 4 *read* province, Baguio, *M. S. Clemens 1039,* on *Pinus insularis, 1303* (B), Haight's Place, *F. Rivera* (supplemental type collection) *50085,* Pauai, *R. C. McGregor 8738;* Bontoc Subprovince, Mount Data, mossy forest, *M. S. Clemens 50084* (type collection), along high.

Page 543. In the twentieth line from the top, *50066* should be referred to *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. forma *macrospora* Humph.

Page 550. In the thirteenth line from the bottom, for *50016* read *50116.*

Page 551. In the last line of the first paragraph, for *50012* read *50112.*

ILLUSTRATIONS

PLATE 1

FIG. 1. *Ganoderma* sp. from the Kew Herbarium, probably from Africa, which has spores similar to those of an authentic specimen of *Polyporus australis* Fr. in the same herbarium. Upper surface of a segment from a large sporophore; × 0.68.

2. Lower surface of the specimen shown in fig. 1; × 0.68.
3. Section of the specimen shown in fig. 1; × 0.77.
4. *Ganoderma* sp. from England, determined by C. Rea as *Ganoderma australe* (Fr.). Upper surface of a section of a sporophore loaned by the Kew Herbarium; × 0.69.
5. Section of the specimen shown in fig. 4; × 0.69.
6. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. Upper surface of a specimen loaned by the Paris Museum labelled "Polyporus tornatus v. B. applanatus, Rawak, Gaudichaud." This is apparently an authentic Persoonian specimen; × 0.68.
7. Lower surface of the specimen shown in fig. 6; × 0.68.
8. Label on the above Persoonian specimen; × 0.53.
9. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. Upper surface of a specimen from the vicinity of Rio Janeiro, Brazil, loaned by the Paris Museum; × 0.68.
10. Lower surface of the specimen shown in fig. 9; × 0.68.
11. Section of the specimen shown in fig. 9; × 0.68.
12. *Ganoderma leucophæum* (Mont.) Pat. Upper surface of a specimen from Montagne's type collection. Loaned by the Paris Museum; × 0.69.
13. Lower surface of the specimen shown in fig. 12; × 0.69.
14. Section, parallel with the base, of the specimen shown in fig. 13; × 0.77.
15. Label on the above specimen of *Ganoderma leucophæum;* × 0.53.

PLATE 2

FIG. 1. *Ganoderma applanatum* (Pers.) Pat. Upper surface of a pale applanate form from England; × 0.54.

2. Lower surface of the specimen shown in fig. 1; × 0.54.
3. Section of specimen shown in fig. 1; × 0.57.
4. *Ganoderma applanatum* (Pers.) Pat. Front view of an ungulate form from England; × 0.57.
5. Section of the specimen shown in fig. 4; × 0.57.
6. *Ganoderma subtornatum* Murr. Upper surface of Elmer's *Philippine Plants 7213*, Palo, Leyte, P. I., cited in the original description. Loaned by the Kew Herbarium; × 0.54.
7. Lower surface of the specimen shown in fig. 6; × 0.54.
8. Section and rear view of the specimen shown in fig. 6; × 0.57.

PLATE 3

FIG. 1. *Ganoderma subtornatum* Murr. Upper surface of Elmer's *Philippine Plants 6943*, Mount Mariveles, Bataan Province, Luzon, P. I. Loaned by the Kew Herbarium; × 0.69.
2. Lower surface of the specimen shown in fig. 1; × 0.69.
3. Section of the specimen shown in fig. 1; × 0.77.
4. *Ganoderma applanatum* (Pers.) Pat. var. *testaceum* Lév. Upper surface of one of the type specimens of *Polyporus testaceus* Lév., from Brazil. Loaned by the Paris Museum; × 0.69.
5. Lower surface of the specimen shown in fig. 4; × 0.69.
6. Upper surface of another specimen in the type collection of *Polyporus testaceus* Lév.; × 0.69.
7. Lower surface of the specimen shown in fig. 6; × 0.69.
8. Section of the specimen shown in fig. 6; × 0.70.
9. Upper surface of still another specimen in the type collection of *Polyporus testaceus* Lév.; × 0.77.
10. Lower surface of the specimen shown in fig. 9; × 0.69.
11. *Fomes marmoratus* Berk. Upper surface of a specimen included in the type collection of *Polyporus testaceus* Lév.; × 0.69.
12. Lower surface of the specimen shown in fig. 11; × 0.69.
13. Section of the specimen shown in fig. 11; × 0.70.
14. Label on the type collection of *Polyporus testaceus* Lév.; × 0.53.
15. *Ganoderma applanatum* (Pers.) Pat. var. *testaceum* Lév. Upper surface of a sporophore, Humphrey herbarium *11059*, Rev. J. Rick, Brazil; × 0.67.
16. Section of the specimen shown in fig. 15; × 0.70.
17. Front view of another specimen of *11059*; × 0.67.
18. Section of another thin specimen of *11059;* × 0.67.
19. *Ganoderma applanatum* (Pers.) Pat. var. *testaceum* Lév. Upper surface of another specimen from Rev. J. Rick, Brazil, Humphrey herbarium *11056;* × 0.67.
20. Section of the specimen shown in fig. 19; × 0.67.

PLATE 4

GANODERMA APPLANATUM (PERS.) PAT. VAR. TORNATUM PERS. FORMA MACROSPORA HUMPH.

FIGS. 1 to 11. Upper and lower surfaces of various specimens of Bureau of Science *50091*, Mount Banahao, Laguna Province, Luzon, P. I.; natural size.
FIG. 12. Section of one of the specimens of *50091;* × 1.03.
FIGS. 13 to 16. Upper and lower surfaces of two specimens of Bureau of Science *50090*, Ubi, Laguna Province, Luzon, P. I. Natural size.
FIG. 17. Section of the specimen shown in figs. 13 and 14; × 1.03.

PLATE 5

LONGISECTIONS OF CRUST, CONTEXT, AND PORES; × 4

FIG. 1. *Ganoderma australe* Fr. Fragment of an authentic specimen from Fries, loaned by the Kew Herbarium.
2. *Ganoderma leucophæum* (Mont.) Pat. Type specimen from the Paris Museum.

FIG. 3. *Ganoderma* sp. from England, determined by C. Rea as *Ganoderma australe* (Fr.).

4. *Ganoderma applanatum* (Pers.) Pat. var. *testaceum* Lév. Type specimen of *Polyporus testaceus* Lév. from the Paris Museum.
5. *Ganoderma* sp. from the Kew Herbarium, probably from Africa, which has spores similar to the authentic specimen of Fries in the same herbarium.
6. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. Authentic Persoonian specimen from the Paris Museum.

PLATE 6

FIG. 1. *Ganoderma subtornatum* Murr. Elmer's *Philippine Plants 7213.* Longisection of context and pores; × 4.

2. Photomicrograph of radial section of the crust of specimen shown in fig. 1; × 121.
3. *Ganoderma subtornatum* Murr. Elmer's *Philippine Plants 6943.* Longisection of context and pores; × 4.
4. Photomicrograph of radial section of the crust of specimen shown in fig. 3; × 121.
5. *Ganoderma* sp. from the Kew Herbarium, probably from Africa, which has spores similar to the authentic specimen of Fries in the same herbarium. Photomicrograph of radial section of the crust; × 121.
6. *Ganoderma* sp. from England, determined by C. Rea as *Ganoderma australe* (Fr.). Photomicrograph of radial section of the crust; × 121.

PLATE 7

PHOTOMICROGRAPHS OF RADIAL SECTIONS OF THE CRUST; × 121

FIG. 1. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. Authentic Persoonian specimen from the Paris Museum.

2. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. Brazilian specimen loaned by the Paris Museum.
3. *Ganoderma applanatum* (Pers.) Pat. Ungulate form from England.
4. *Ganoderma applanatum* (Pers.) Pat. Pale applanate form from England.
5. *Ganoderma leucophæum* (Mont.) Pat. Type collection from the Paris Museum.
6. *Ganoderma applanatum* (Pers.) Pat. var. *testaceum* Lév. Type collection of *Polyporus testaceus* Lév. from the Paris Museum.

PLATE 8

PHOTOMICROGRAPHS OF CROSS SECTIONS OF THE PORES; × 121

FIG. 1. *Ganoderma australe* (Fr.). Authentic specimen from Fries in the Kew Herbarium.

2. *Ganoderma* sp. from the Kew Herbarium, probably from Africa, which has spores similar to the authentic specimen of Fries in the same herbarium.

FIG. 3. *Ganoderma* sp. from England, determined by C. Rea as *Ganoderma australe* (Fr.).

4. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. Authentic Persoonian specimen from the Paris Museum.
5. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. Brazilian specimen loaned by the Paris Museum.
6. *Ganoderma applanatum* (Pers.) Pat. Pale applanate form from England.
7. *Ganoderma applanatum* (Pers.) Pat. Ungulate form from England.
8. *Ganoderma leucophæum* (Mont.) Pat. Type collection from the Paris Museum.

PLATE 9

PHOTOMICROGRAPHS OF CROSS AND LONGISECTIONS OF PORES; × 121

FIG. 1. *Ganoderma applanatum* (Pers.) Pat. var. *testaceum* Lév. Type collection of *Polyporus testaceus* Lév. from the Paris Museum.

2. *Ganoderma subtornatum* Murr. Elmer's *Philippine Plants 7213.*
3. *Ganoderma subtornatum* Murr. Elmer's *Philippine Plants 6943.*
4. *Ganoderma australe* (Fr.). Authentic Friesian specimen from the Kew Herbarium.
5. *Ganoderma* sp. from the Kew Herbarium, probably from Africa, which has spores similar to the authentic specimen of Fries in the same herbarium.
6. *Ganoderma* sp. from England, determined by C. Rea as *Ganoderma australe* (Fr.).
7. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. Authentic Persoonian specimen from the Paris Museum.
8. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. Brazilian specimen from the Paris Museum.

PLATE 10

PHOTOMICROGRAPHS OF LONGISECTIONS OF PORES; × 121

FIG. 1. *Ganoderma applanatum* (Pers.) Pat. Pale applanate form from England.

2. *Ganoderma applanatum* (Pers.) Pat. Ungulate form from England.
3. *Ganoderma leucophæum* (Mont.) Pat. Type collection from the Paris Museum.
4. *Ganoderma applanatum* (Pers.) Pat. var. *testaceum* Lév. Type collection of *Polyporus testaceus* Lév. from the Paris Museum.
5. *Ganoderma subtornatum* Murr. Elmer's *Philippine Plants 7213.*
6. *Ganoderma subtornatum* Murr. Elmer's *Philippine Plants 6943.*

PLATE 11

PORE SURFACES; × 20

FIG. 1. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. Authentic Persoonian specimen from the Paris Museum.

2. *Ganoderma leucophæum* (Mont.) Pat. Type from the Paris Museum.

FIG. 3. *Ganoderma applanatum* (Pers.) Pat. var. *testaceum* Lév. Type collection of *Polyporus testaceus* Lév. from the Paris Museum.

4. *Ganoderma subtornatum* Murr. Elmer's *Philippine Plants 6943.*
5. *Ganoderma subtornatum* Murr. Elmer's *Philippine Plants 7213.*

PLATE 12

SPORES; × 780

FIG. 1. *Ganoderma australe* (Fr.). From a crushed mount of the pores of the authentic Friesian specimen from the Kew Herbarium.

2. *Ganoderma* sp. from the Kew Herbarium, probably from Africa, which has spores quite similar to the authentic Friesian specimen. From the upper surface.
3. *Ganoderma* sp. from England, determined by C. Rea as *Ganoderma australe* (Fr.). From a crushed mount of the pores.
4. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. From a crushed mount of the pores of the authentic Persoonian specimen from the Paris Museum.
5. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. From the upper surface of the Brazilian specimen from the Paris Museum.
6. *Ganoderma applanatum* (Pers.) Pat. From the upper surface of the pale applanate form from England.
7. *Ganoderma applanatum* (Pers.) Pat. From the upper surface of the ungulate specimen from England.
8. *Ganoderma leucophæum* (Mont.) Pat. From a crushed mount of the pores of the type specimen from the Paris Museum.
9. *Ganoderma applanatum* (Pers.) Pat. var. *testaceum* Lév. From the upper surface of one of the type specimens of *Polyporus testaceus* Lév. from the Paris Museum.
10. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers. forma *macrospora* Humph. From the upper surface of *Bureau of Science 50091.*
11. *Ganoderma subtornatum* Murr. From a crushed mount of the pores of Elmer's *Philippine Plants 7213.*
12. *Ganoderma subtornatum* Murr. From a crushed mount of the pores of Elmer's *Philippine Plants 6943.*
13. *Ganoderma subtornatum* Murr. From the upper surface of Elmers' *Philippine Plants 6943.*

INDEX TO SPECIMENS FIGURED

Ganoderma applanatum (Pers.) Pat. Pale applanate form from England. Plate 2, figs. 1 to 3; Plate 7, fig. 4; Plate 8, fig. 6; Plate 10, fig. 1.

Ganoderma applanatum (Pers.) Pat. Ungulate form from England. Plate 2, figs. 4, 5; Plate 7, fig. 3; Plate 8, fig. 7; Plate 10, fig. 2; Plate 12, fig. 7.

Ganoderma sp., from Kew Herbarium, probably from Africa. Spores similar to those of an authentic specimen of *Polyporus australis.* Plate 1, figs. 1 to 3; Plate 5, fig. 5; Plate 6, fig. 5; Plate 8, fig. 2; Plate 9, fig. 5; Plate 12, fig. 2.

Ganoderma sp., from England, determined by Rea as *Ganoderma australe* Fr. Plate 1, figs. 4, 5; Plate 5, fig. 3; Plate 6. fig. 6; Plate 8, fig. 3; Plate 9, fig. 6; Plate 12, fig. 3.

Ganoderma australe (Fr.). Authentic Friesian specimen from Kew Herbarium. Plate 5, fig. 1; Plate 8, fig. 1; Plate 9, fig. 4; Plate 12, fig. 1.

Ganoderma applanatum (Pers.) Pat. var. *tornatum* Pers., from Brazil, loaned by the Paris Museum. Plate 1, figs. 9 to 11; Plate 7, fig. 2; Plate 8, fig. 5; Plate 9, fig. 8; Plate 12, fig. 5.

Ganoderma applanatum (Pers.) Pat. var. *tornatum* Pers. Authentic Persoonian specimen of *Polyporus tornatus* v. *B. applanatus*. Plate 1, figs. 6 and 7; Plate 5, fig. 6; Plate 7, fig. 1; Plate 8, fig. 4; Plate 9, fig. 7; Plate 11, fig. 1; Plate 12, fig. 4.

Ganoderma applanatum (Pers.) Pat. var. *tornatum* Pers. forma *macrospora* Humph. 50,090 (B. S.) Plate 4, figs. 13 to 16; 50,091 (B. S.) Plate 4, figs. 1 to 12; Plate 12, fig. 10.

Ganoderma leucophæum (Mont.) Pat. Montagnes type collection from Paris Museum. Plate 1, figs. 12 to 14; Plate 5, fig. 2; Plate 7, fig. 5; Plate 8, fig. 8; Plate 10, fig. 3; Plate 11, fig. 2; Plate 12, fig. 8.

Ganoderma subtornatum Murr. *Elmer 6943.* Plate 3, figs. 1 to 3; Plate 6, figs. 3 and 4; Plate 9, fig. 3; Plate 10, fig. 6; Plate 11, fig. 4; Plate 12, figs. 12 and 13.

Elmer 7213. Plate 2, figs. 6 to 8; Plate 6, figs. 1 and 2; Plate 9, fig. 2; Plate 10, fig. 5; Plate 11, fig. 5; Plate 12, fig. 11.

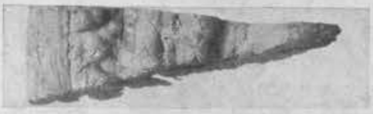
Ganoderma applanatum (Pers.) Pat. var. *testaceum* Lév. Type specimens of *Polyporus testaceus* Lév. Plate 3, figs. 4 to 10; Plate 5, fig. 4; Plate 7, fig. 6; Plate 9, fig. 1; Plate 10, fig. 4; Plate 11, fig. 3; Plate 12, fig. 9.

11056 (*H*). Plate 3, figs. 19 and 20.

11059 (*H*). Plate 3, figs. 15 to 18.

INDEX TO PLATES

PLATES 1 to 4. Sporophores.
PLATE 5. Longisections of crusts, context, and pores.
PLATE 6, FIGS. 1 and 3. Longisections of context and pores.
PLATE 6. FIGS. 2, 4 to 6. Photomicrographs of structure of crust.
PLATE 7. Photomicrographs of structure of crust.
PLATES 8 to 10. Photomicrographs of crust and longisections of pores.
PLATE 11. Pores surfaces, enlarged.
PLATE 12. Photomicrographs of spores.



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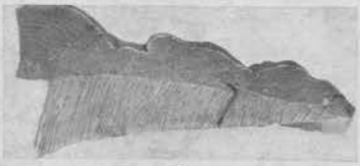

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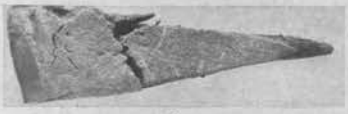

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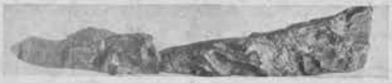

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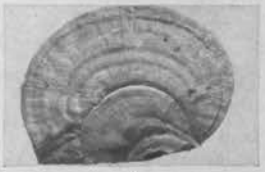

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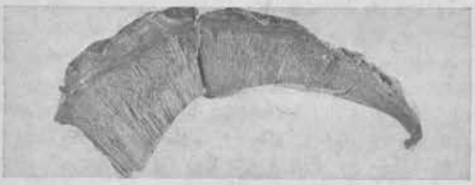

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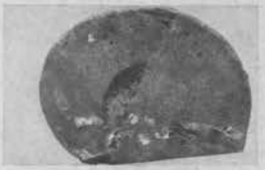

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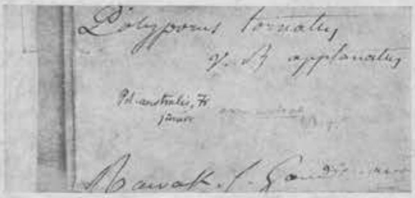

Polyporus tornatus,
v. β applanatus

Pol. australis, Fr.
junior

Rawak. l. Gaudich.

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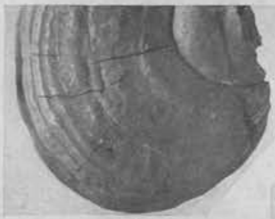

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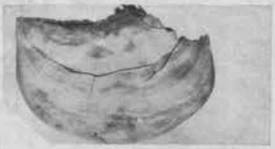

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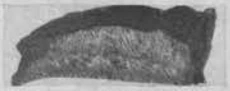

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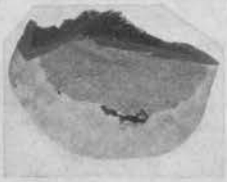

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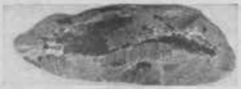

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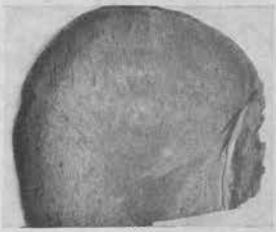

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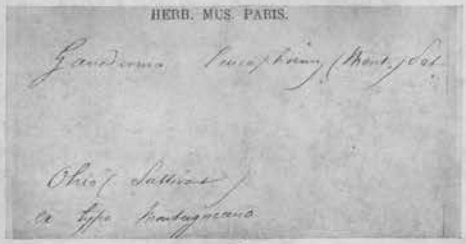


HERB. MUS. PARIS.

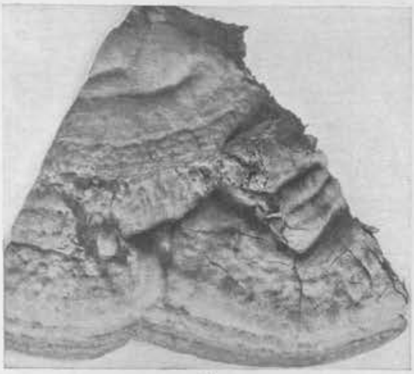
Ganoderma leucophæum (Mont.) Pat.

Ohio (Sullivant)

ex typo Montagneano

15

PLATE 1.



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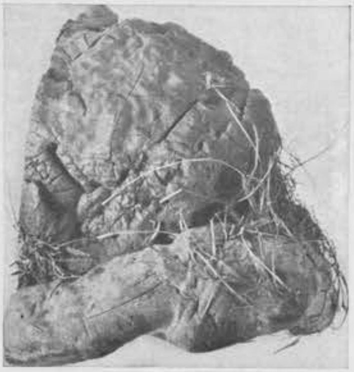

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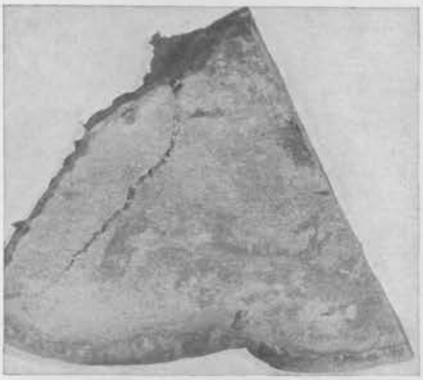

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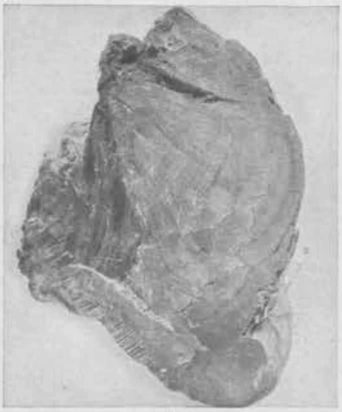

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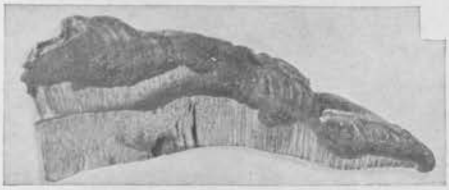

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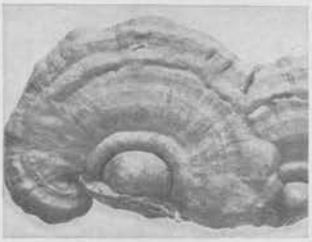

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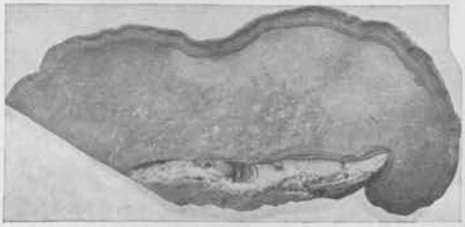

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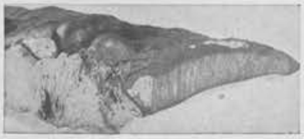

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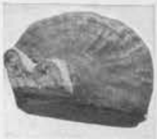
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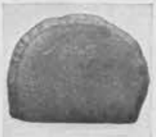
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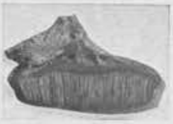
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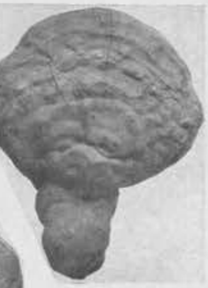
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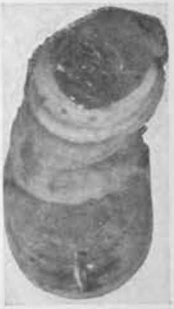
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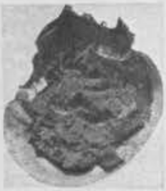
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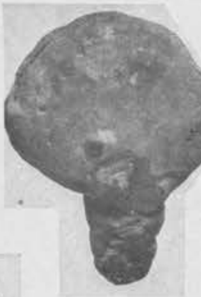
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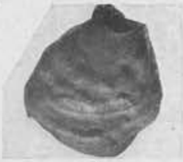
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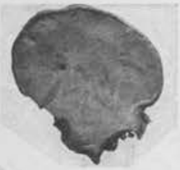
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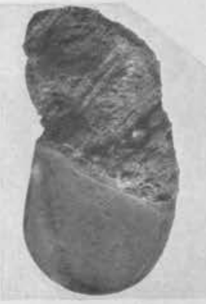
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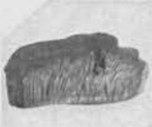
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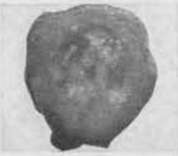
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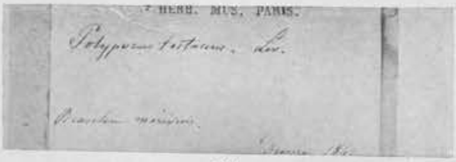
HERB. MUS. PARIS.

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Brasilia meridion.

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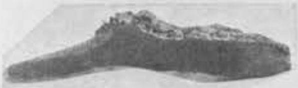
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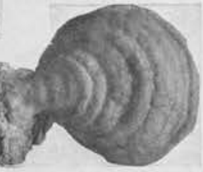
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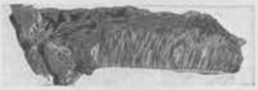
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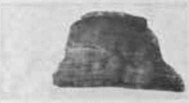
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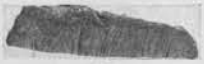
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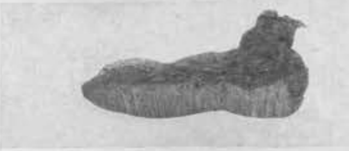
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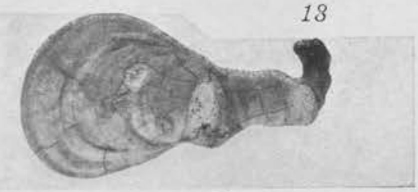
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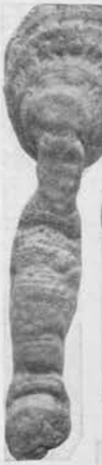
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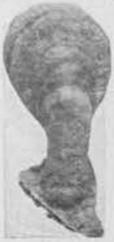
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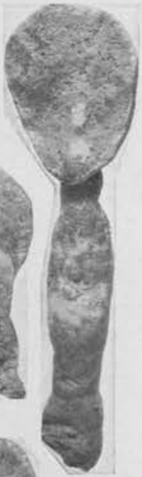
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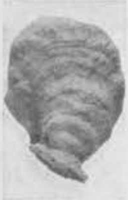
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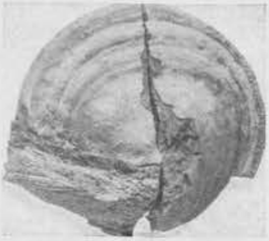
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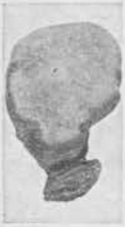
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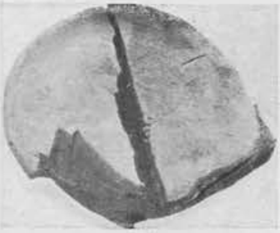
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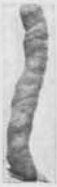
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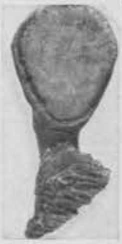
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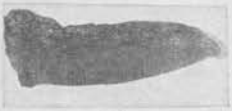
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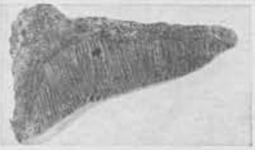
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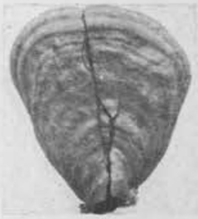
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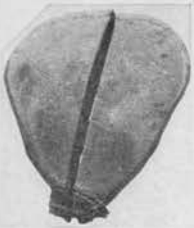
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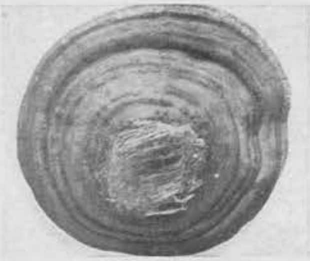
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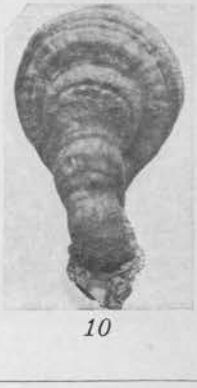
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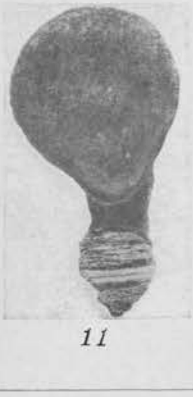
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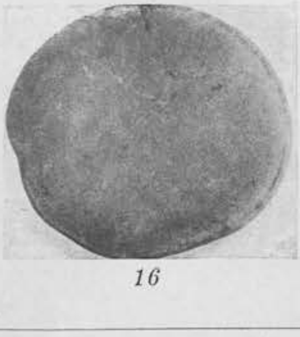
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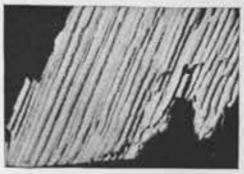

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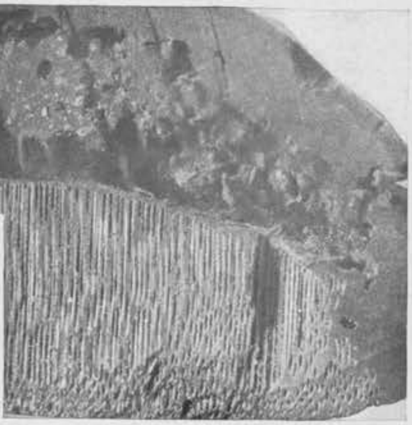

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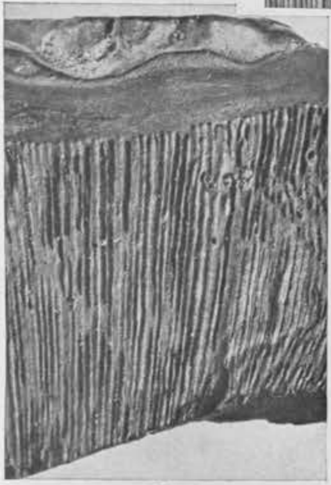

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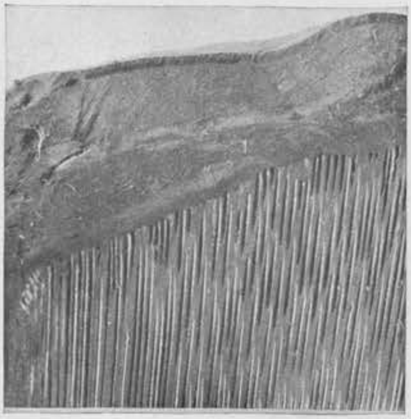

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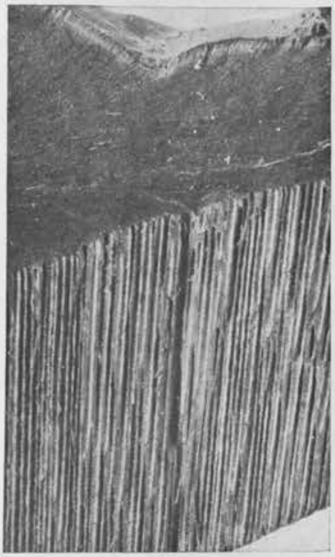

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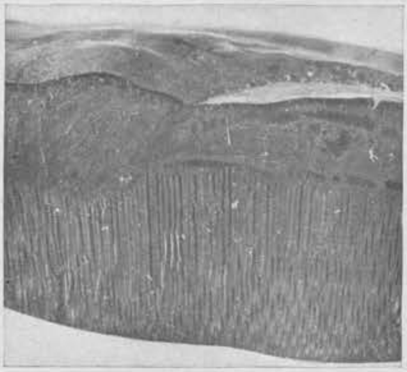

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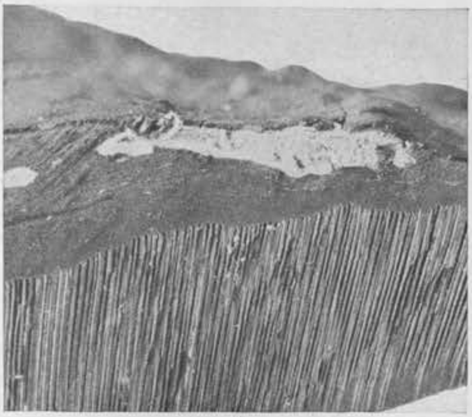

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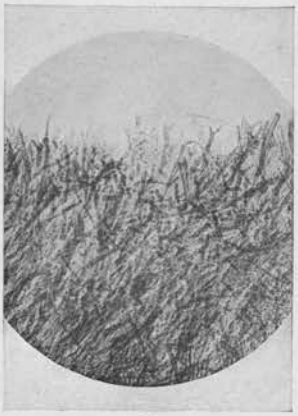

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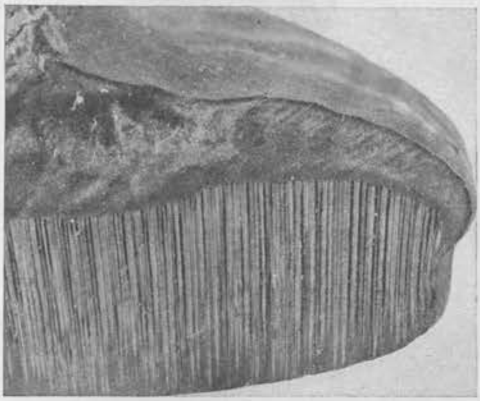

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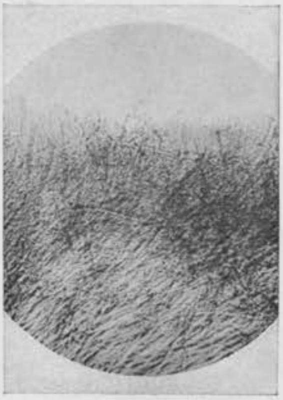

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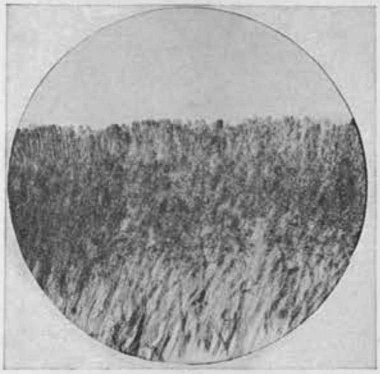

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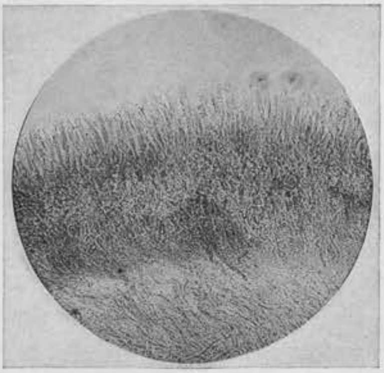

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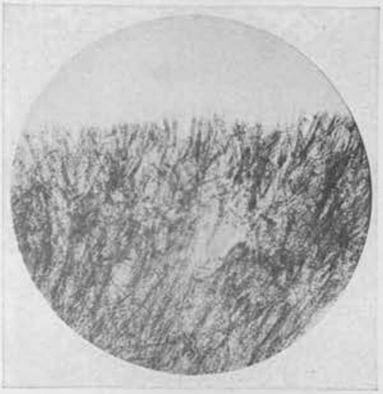

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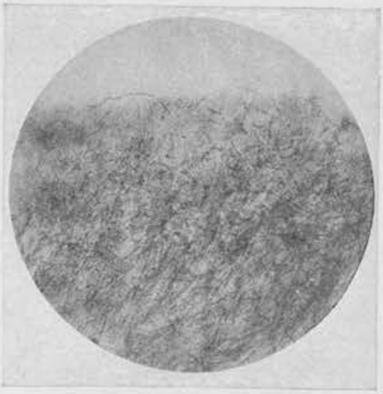

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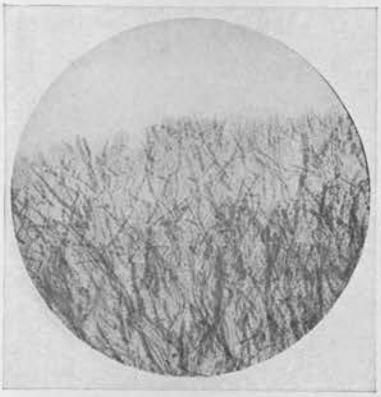

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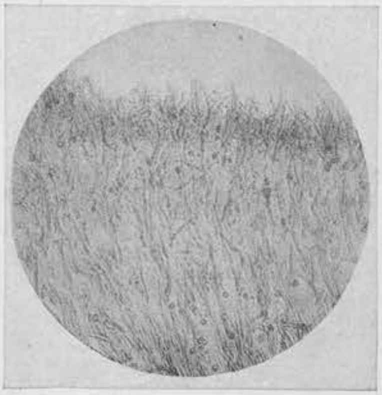

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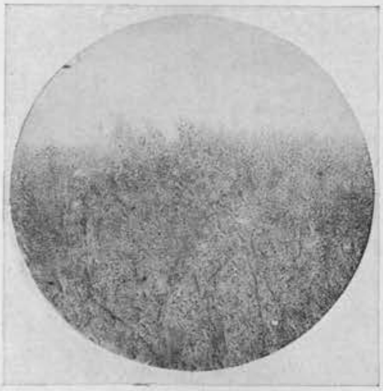

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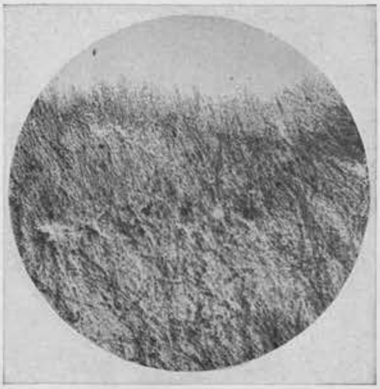

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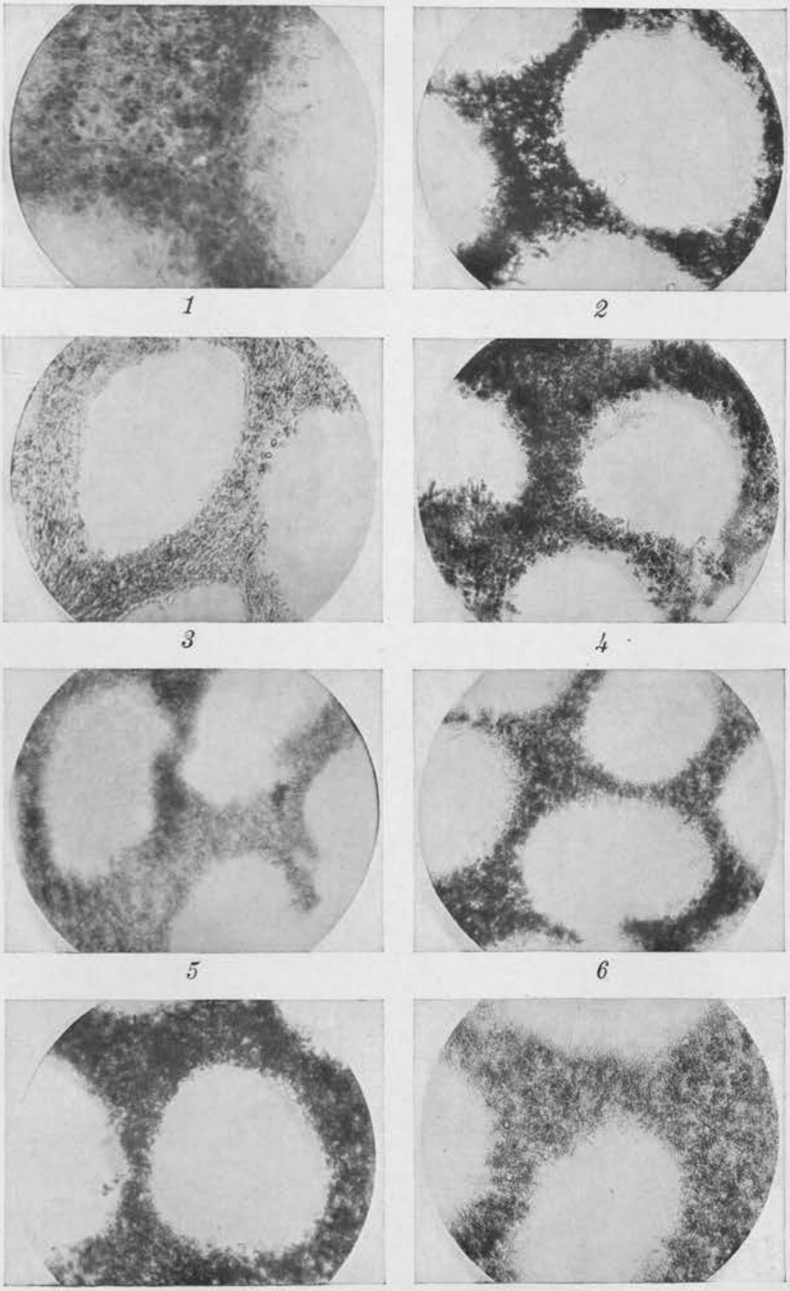

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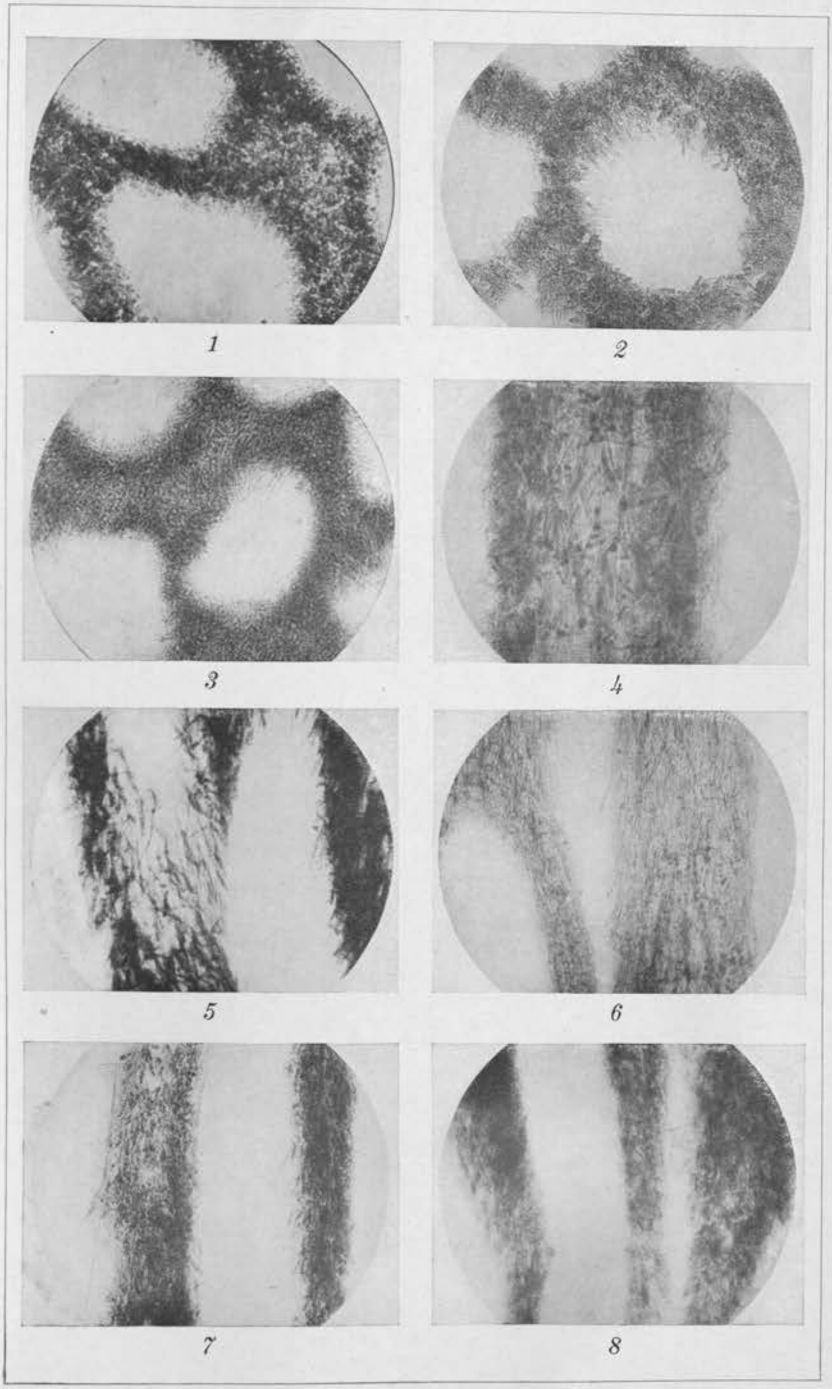

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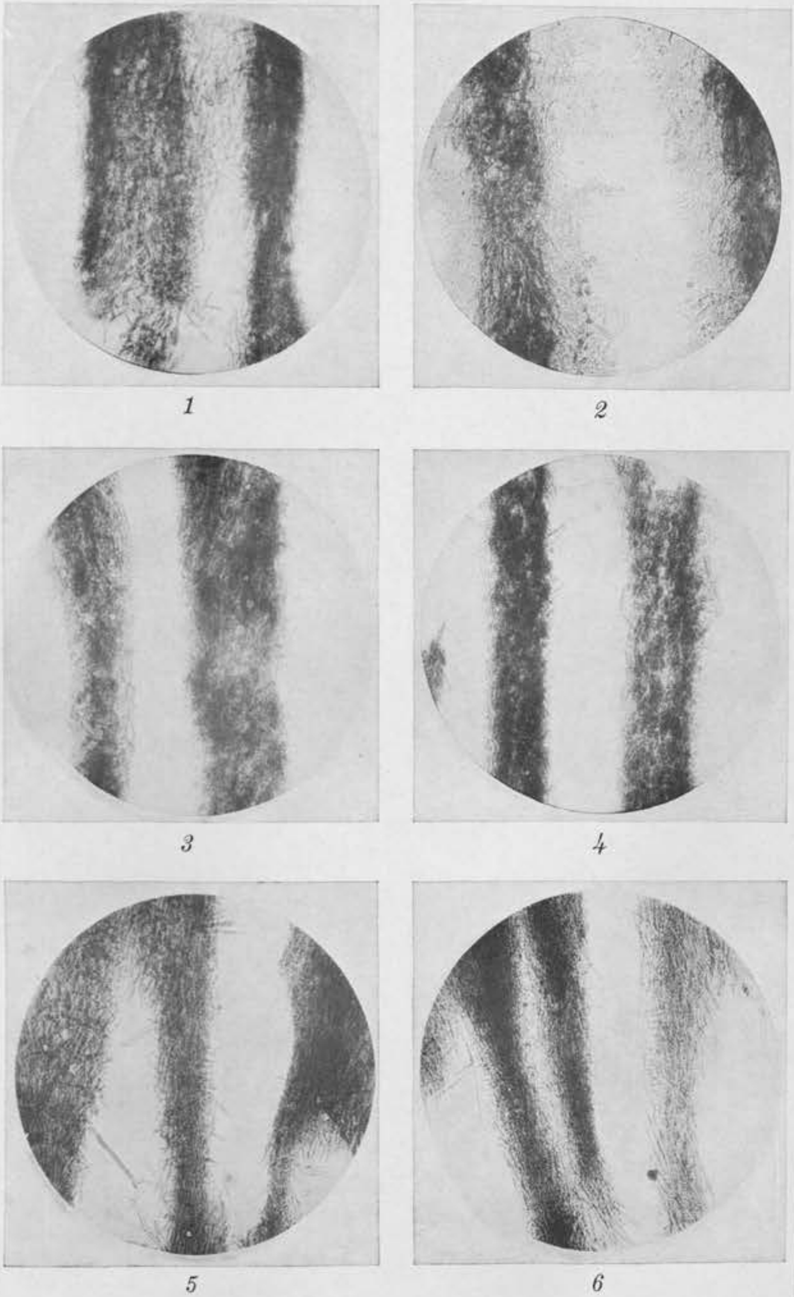

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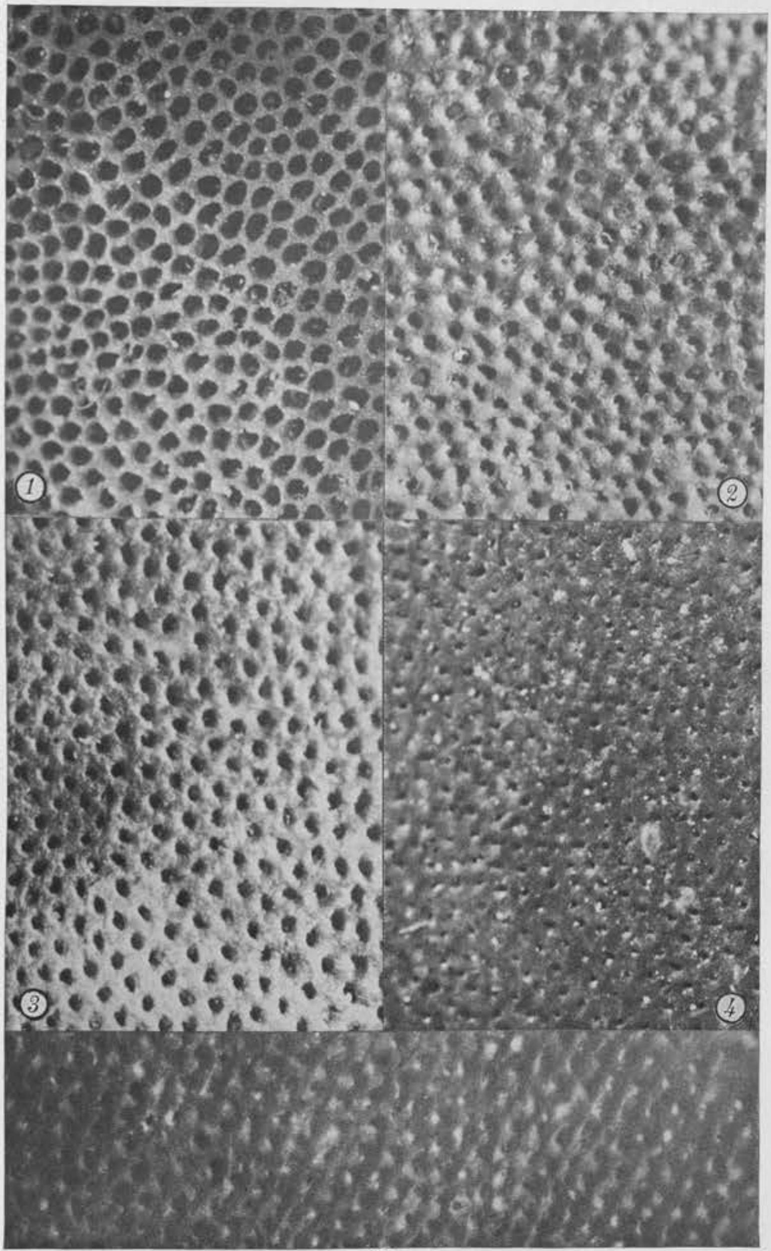

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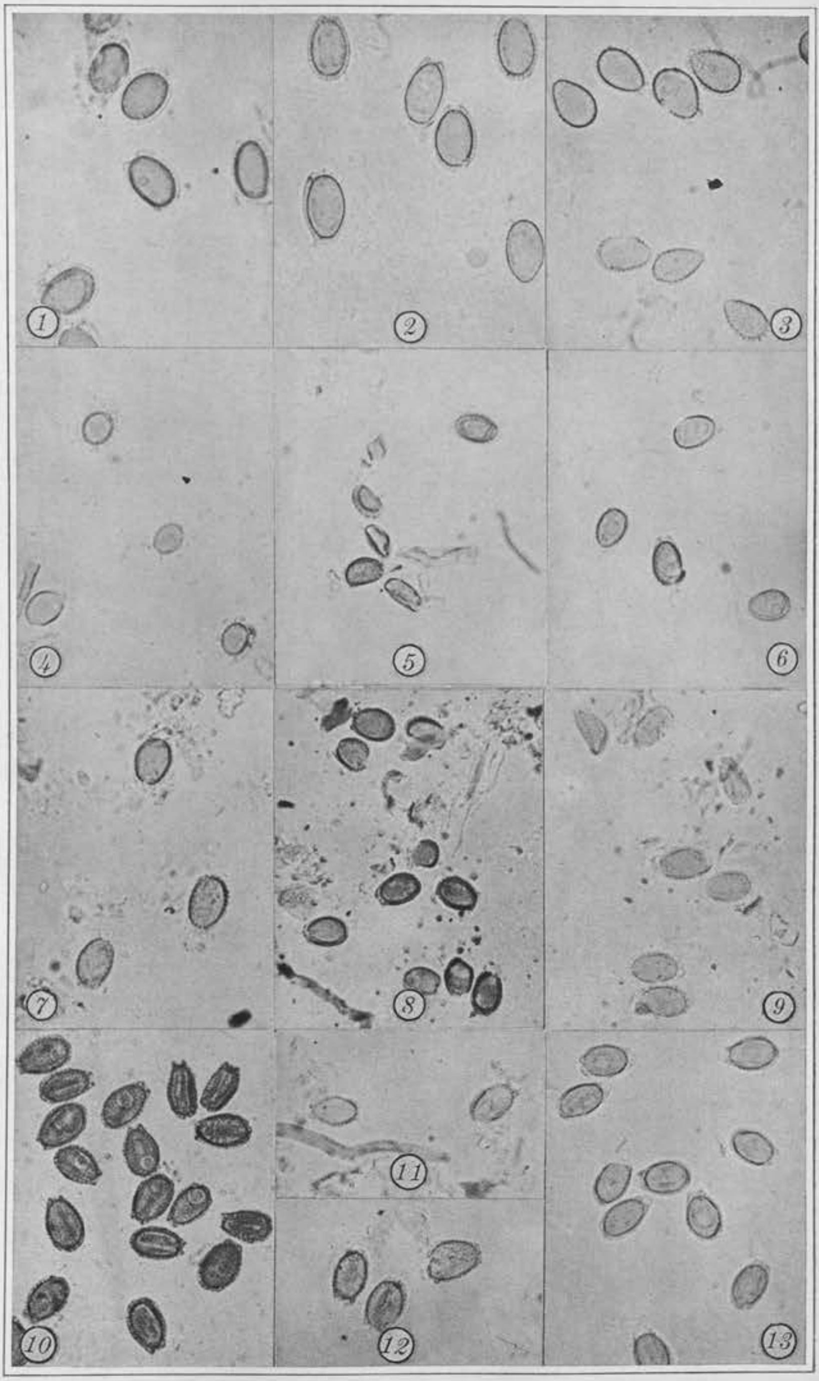

PLATE 12.

NEW OR NOTEWORTHY PHILIPPINE FUNGI, II

By José Miguel Mendoza

Associate Mycologist, Bureau of Science, Manila

TEN PLATES

INTRODUCTION

The Philippine flora is especially rich in the lower fungi and these offer very interesting material for mycological research. Although many collections have been named there remain in the Bureau of Science herbarium numerous specimens collected in different parts of the Archipelago which are undoubtedly new to science. It is the purpose of the writer to work over this collection as time permits and to report the results in a series of papers, of which this constitutes the second.[1] All the types have been deposited in the herbarium of the Bureau of Science, Manila.

FAMILY MICROTHYRIACEÆ SACCARDO AND SYDOW

ASTERINA XYLOSMAE sp. nov. Plate 1, figs. 1 to 5.

Colonia fungosa epiphylla, raro hypophylla, maculas orbiculatas et ad marginem irregulares, atras, non aequabiliter distributas et paene totam superficiem folii occupantes efformans; mycelio affluenti, fere a latere ramoso, ramis oppositis vel alternantibus; ex hyphis sucineo colore vel atro-fuscis, internodiis 21 ad 23 μ longis, 6 ad 7 μ latis; hyphopodiis 2-loculatis, numerosis, cylindraceis, juxta terminum rotundatis velraro leniter lobatis, alternatis vel generatim oppositis, ex hyphis a latere proclivibus, 11 ad 19 μ longis, 10 ad 11 μ latis; peritheciis paucis, globosis, 200 ad 361 μ diam.; stellatim dehiscentibus, contextu ex hyphis flavis vel subfuscis, quoad earum parietes, undulatis, 3 ad 4 μ latis, composito; ambitu non fimbriatis; ascis subglobosis vel generatim globosis, 8-sporiis, 47 ad 63 longis, 41 ad 57 μ latis; aparaphysatis; sporidiis immature hyalinis, mature fuscis, ellipsoideis, 1-septatis, medio constrictis, utrinque rotundatis; 16 ad 19 μ longis, 10 ad 11 μ latis.

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[1] The first was published in the Philip. Journ. Sci. 47 (1932) 289–294.

The fungus forms round black spots with irregular margin, 1 to 8 mm in diameter. It is mostly epiphyllous, scattered or almost covering the surface of the leaf. Mycelium thick, laterally branched; branches opposite or alternate, composed of amber to dark brown hyphæ, 21 to 23 μ long, 6 to 7 μ wide. Hyphopodia abundant, usually lateral, cylindric, rounded at the end or rarely slightly lobed, 2-celled, generally opposite, seldom alternate, 11 to 19 μ long, 10 to 11 μ wide. Perithecia few, globose, 200 to 361 μ in diameter; the walls splitting in a stellate manner and composed of sinuous, straw-colored to light brown hyphæ, 3 to 4 μ wide.

Asci usually globose, occasionally subglobose, 8-spored, 47 to 63 μ long, 41 to 57 μ wide; paraphyses none. Spores smooth, ellipsoid, constricted at the single septum, rounded at both ends, brown when mature, 16 to 19 μ long, 10 to 11 μ wide.

LUZON, Ilocos Norte Province, Bangui, *Bur. Sci. 27705, M. Ramos* (type), February, 1917, on leaves of *Xylosma.*

ASTERINA PLECTRONIAE sp. nov. Plate 2, figs. 1 to 5.

Colonia fungosa epiphylla, rarissime hypophylla; maculas irregulares, minus 1 mm diam. regionibus indefinitis, marginalibus atriis, et membranaceis circumdatas, subinde confluente et majorem partem folii occupantes efformans; mycelio parce distributo, raro ramoso et tunc ramis alternantibus, parietibus subasperis ex hyphis atrofuscis, 6 ad 7 μ latis, hyphopodiis brevibus, cylindraceis, numerosis, oppositis, 1-loculatis, acutis vel saltem ad terminos non rotundatis, a latere ab hyphis provenientibus, 11 ad 13 μ latis; peritheciis satis numerosis, globosis, limosis, 250 ad 291 μ diam., stellatim dehiscentibus, contextu ex hyphis fuscis, 5 ad 6 μ latis; ambitu valde fimbriato; ascis numerosis, globosis vel generatim ovatis; 8-sporiis, 60 ad 63 μ longis, 44 ad 60 μ latis; aparaphysatis; sporidiis immature hyalinis, mature fuscis, ellipsoideis, 1-septatis, medio constrictis, utrinque rotundatis, 27 ad 30 μ longis, 12 ad 16 μ latis.

The fungus produces irregular, usually epiphyllous, rarely hypophyllous, spots varying from less than 1 mm in diameter to confluent patches nearly covering the surface of the leaf. The mycelium is rather inclined to be sparse, seldom abundant, composed of dark brown hyphæ, 6 to 7 μ wide; branches few, alternate; walls roughened. Hyphopodia one-celled, numerous, opposite, short, cylindrical, inclined to be pointed, never rounded at the end, springing laterally from the mycelium, 11 to 13 μ long, 5 to 6 μ wide. Perithecia quite numerous, slimy, dark brown, globose, 250 to 291 μ in diameter; walls splitting in a stellate fashion, composed of brown hyphæ, 5 to 6 μ wide.

Asci abundant, generally ovate, seldom globose, 8-spored, 60 to 63 μ long, 44 to 60 μ wide; paraphyses none. Spores smooth, ellipsoid, 1-septate, constricted at the single septum, rounded at both ends, brown when mature, 27 to 30 μ long, 12 to 16 μ wide.

LUZON, Ilocos Norte Province, Burgos, *Bur. Sci. 33399 M. Ramos* (type), July 22, 1918, on leaves of *Plectronia cumingii* Elm.

This fungus somewhat resembles *Asterina xylosmae*, both having opposite hyphopodia and mycelial hyphæ of the same size. It also rather closely resembles *Asterina opposita* Syd.[2] in many characters, the hyphopodia of both being opposite, one-celled, and nearly the same in size. The hyphopodia of *A. opposita*, however, are rounded at the end, while those of *A. plectroniae* are more or less pointed, at least not rounded; they are more numerous in *A. opposita*. The mycelial hyphæ, the hyphæ that constitute the perithecia, and the spores, are almost identical in size in the two fungi. The principal difference lies in the perithecia of *A. plectroniae* being very much larger, darker in color, slimy, and very strongly fringed; the asci are also larger.

ASTERINA PLECTRONIAECOLA sp. nov. Plate 3, figs. 1 to 5.

Colonia fungosa amphigena, maculas irregulares atras efformans tenues, 2 mm—fere 8 mm diam., non aequabiliter distributas, quae vix discerni possunt per folii superficiem; mycelio exiguo, tenuiter ramoso, ex hyphis sucineo colore vel fuscis, crassis, 4.5 ad 6 μ latis, composito; hyphopodiis paucis, cylindraceis, 1-loculatis, ad apicem rotundatis vel rarissime simpliciter lobatis, irregulariter ordinatis, 10 ad 13 μ longis, 5 ad 6 μ latis; peritheciis paucis, rotundatis, limosis, atro-fuscis, 80 ad 160 μ diam; fimbriatis, stellatim dehiscentibus; contextu ex hyphis quoad parietes undatis, 2.5 ad 3 μ latis; ambitu parce fimbriatis; ascis paucis, globosis vel generatim ovato-globosis, 8-sporiis, 35 ad 41 μ longis, 28 ad 35 μ latis; aparaphysatis, sporidiis ellipsoideis, laevibus, oblongis, fuscis, intra ascum conglomeratis, 1-septatis, loculo superiore majore, 25 ad 29 μ longis, 10 ad 13 μ latis.

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[2] Leafl. Philip. Bot. 6 (1913) 1926.

This fungus forms irregular, thin, black, amphigenous spots varying from less than 2 mm to about 8 mm in diameter, not uniformly distributed on the surface of the leaf. Mycelium thin, rarely branched, the hyphæ amber to brown in color, thick-walled, 4.5 to 6 μ wide. Hyphopodia few, one-celled, cylindrical, the ends rounded or simply lobed, 10 to 13 μ long, 5 to 6 μ wide. Perithecia few, globose, slimy, dark brown, 80 to 160 μ in diameter with a fimbriate margin; walls splitting in a stellate manner, composed of sinuous hyphæ, 2.5 to 3 μ in diameter.

Asci few, ovate-globose, rarely globose, 35 to 41 μ long, 28 to 45 μ wide; paraphyses none. Spores oblong-elliptic, smooth, conglomerated within the ascus, constricted at the single septum, the superior cell the larger, rounded at both ends, brown, 25 to 29 μ long, 10 to 13 μ wide.

CATANDUANES, Calatagan and vicinity, *Bur. Sci. 30585, M. Ramos* (type), December 11, 1917, on leaves of *Plectronia gynochthodes.*

This fungus is quite similar to *Asterina densa* H. and P. Syd.[3] in many characteristics, but differs in its somewhat larger spores, asci, and smaller perithecia.

ASTERINA PHALERIAE sp. nov. Plate 4, figs. 1 to 5.

Colonia fungosa epiphylla, rarissime hypophylla, maculas minus 1 mm irregulares vel indefinites et quasi membranaceas, majorem partem superiorem folii occupantes efformans; mycelio satis infrequenti, perparce ramoso, ex hyphis flavis vel fuscis, 4.5 ad 6 μ latis composito; hyphopodiis sat frequentibus, cylindraceis, distincte lobatis, irregulariter ordinatis, 10 ad 12 μ longis, 6 ad 7 μ latis; peritheciis infrequentibus, rotundatis, 80 ad 120 μ diam.; stellatim dehiscentibus, contextu ad marginem flavo, atro-fusco ad partem centralem, ex hyphis quoad parietes undatis, 3 ad 4 μ latis; ambitu valde fimbriatis; ascis paucis, globato-ovatis vel generatim globosis, 8-sporiis, 30 ad 35 μ longis, 25 ad 31 μ latis, aparaphysatis; sporidiis ellipsoido-oblongis, 1-septatis, medio constrictis, loculo superiore majore, fuscis, 17 ad 22 μ longis, 9 ad 11 μ latis.

The fungus starts as marginate, irregular, epiphyllous, very seldom hypophyllous, spots less than 1 mm in diameter. It later becomes widely effused and forms a coating over the greater portion of the leaf surface. The mycelium is thin, composed of amber-colored to brown hyphæ, 4.5 to 6 μ wide; branches very few. Hyphopodia quite abundant, with no definite arrangement, one-celled, cylindric, distinctly lobed, 10 to 12 μ long, 6 to 7 μ wide. Perithecia few, globose, 80 to 121 μ in diameter, very strongly fringed at the periphery; walls splitting in a stellate manner, dark brown at the central portion, becoming amber-colored toward the margin; perithecial hyphæ sinuous, 3 to 4 μ wide.

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[3] Ann. Myc. 12 (1914) 557.

Asci few, globose, rarely globose-ovate, 8-spored, 30 to 35 μ long, 25 to 31 μ wide; paraphyses none. Spores brown, warted oblong-elliptic, constricted at the single septum, the superior cell being the larger, 17 to 22 μ long, 9 to 11 μ wide.

PANAY, Capiz Province, Libacao, *Bur. Sci. 35857 A. Martelino and G. Edaño* (type), June 13, 1919, on leaves *of Phaleria perrottetiana* (Decne.) F.-Vill.

There is a close resemblance between this fungus and *Asterina pipturi* Syd.,[4] the spores of both fungi being warted and ellipsoid, although those of *A. phaleriae* are more oblong. The asci and mycelial hyphæ of the two fungi are nearly similar in shape and size. The principal differences lie in the much larger perithecia and the more distinctly lobed and stouter hyphopodia of *A. phaleriae.*

ASTERINELLA CAPIZENSIS sp. nov. Plate 5, figs. 1 to 5.

Colonia fungosa stricte epiphylla, maculas irregulares, orbiculares de 1 mm ad 1 cm, confluentes, non aequabiliter sparsas per folii superficiem efformans; mycelio infrequenti, plus minusve irregulariter confluenti, ramoso, ex hyphis flavis vel fuscis, 3.5 ad 6 μ latis; desunt hyphopodia; perithecia frequentibus, globosis, 95 ad 200 μ diam., stellatim dehiscentibus; contextu ex hyphis cinereo-fuscis vel atro fuscis, septatis, 3 ad 5.5 μ latis composito; ascis paucis, ovato-globosis vel generatim globosis, 8-sporiis, 31 ad 39 μ longis, 31 ad 36 μ latis; aparaphysatis; sporidiis ellipsoideis, brevibus, utrinque rotundatis, laevibus, 1-septatis, medio constrictis, 19 ad 22 μ longis, 9 ad 10 μ latis.

The fungus is epiphyllous, producing round black spots with irregular margin, ranging from 1 mm to about 1 cm in diameter, these soon coalescing to form scattered irregular areas on the surface of the leaf. Mycelium thin, the branches fusing, composed of amber to brown hyphæ, 3.5 to 6 μ wide. Hyphopodia none. Perithecia abundant, globose, 95 to 200 μ in diameter; the walls easily splitting in a stellate manner and composed of radiating ashy brown to dark brown, septate hyphæ, 3 to 5.5 μ in diameter.

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[4] Ann. Myc. 14 (1916) 366.

Asci globose, rarely ovate-globose, 8-spored, 31 to 39 μ long, 31 to 38 μ wide; paraphyses none. Spores smooth, ellipsoid, short, rounded at both ends, constricted at the single septum, 19 to 22 μ long, 9 to 10 μ wide.

PANAY, Capiz Province, Capindan, San Juan Barrio, *Bur. Sci. 32109, M. Ramos and G. Edaño* (type), April 11, 1918, on leaves of *Leucosyke capitellata* (Poir.) Wedd.

This species very closely approaches *Asterinella ramuligera* Syd. The two species have the same shape of spores and asci. Both are aparaphysate and even in size of asci and spores there is but little difference. The main distinction lies in that *Asterinella phaleriae* is epiphyllous and has smooth spores, while *Asterinella ramuligera* is amphigenous, and has warted spores.

ASTEROMYXA SURIGAOENSIS sp. nov. Plate 6, figs. 1 to 7.

Colonia fungosa copiosa, stricte epiphylla, maculas efformans irregulares ad marginem, orbiculatas, de 1 mm (circiter) ad 1 cm diam., non aequabiliter ordinatas per folii superficiem; mycelio perexiguo, intertexto fulvo vel flavo colore; ex hyphis 6 μ latis, setosis; desunt hyphopodia; peritheciis frequentibus, orbiculatis, 86 ad 102 μ diam., perlucidis ita ut hymenia sint paene visibilia; contextu, qui facile amoveri potest, squamoso ex hyphis fulvis vel atrofuscis, 4 μ latis, composito; ambitu valde fimbriatis; ascis sat frequentis, 8-sporiis, globo-ovatis, 31 ad 44 μ longis, 19 ad 27 μ latis; aparaphysatis; sporidiis immaturis hyalinis, maturis fulvis vel flavis, ellipsoideis, oblongis, 1-septatis, utrinque rotundatis, medio constrictis, 14 ad 19 μ longis, 8 ad 9 μ latis; conidiis numerosis, brevibus, ellipsoideis, fulvis vel fuscis, 14 ad 18 μ longis, 9 ad 10 μ latis.

The fungus forms abundant round spots with irregular margin, strictly epiphyllous, varying from about 1 mm to 1 cm in diameter, unevenly distributed on the surface of the leaf. Mycilium sparse, intertwining, composed of straw-colored to light brown hyphæ, 6 μ wide; setose. Hyphopodia none, perithecia abundant, globose 86 to 102 μ in diameter, more or less transparent so that the hymenial layer inside is nearly visible; walls sloughing off to a considerable degree, composed of straw to dark brown hyphæ, 4 μ wide; periphery very strongly fringed.

Asci abundant, globose-ovate, 31 to 44 μ long, 19 to 27 μ wide, 8-spored; paraphyses none. Spores oblong-elliptic, rounded at both ends, constricted at the single septum, hyaline when young, amber-colored to brown when mature, 14 to 19 μ long, 8 to 9 μ wide. Conidia numerous, elliptical, short, amber to brown, 14 to 18 μ long, 9 to 10 μ wide.

MINDANAO, Surigao Province, Surigao, *Bur. Sci. 35901, M. Ramos and Pascasio* (type), May 18, 1919, on *unknown host* (Anonaceae).

This is the first species of *Asteromyxa* ever reported in the Philippines.

FAMILY CAPNODIACEÆ VON HÖHNEL

AITHALODERMA FICI sp. nov. Plate 7, figs. 1 to 3; Plate 8, figs. 1 to 6.

Colonia fungosa superficialis, amphigena, quamvis multum crassior per superiorem folii superficiem, aspera, atra, saepe totam superficiem obtegens, a substantia folii sine dificultate amovibilis at tunc speciem cutis membranacea habens; mycelio dematiaceo, abundanti crasso, irregulariter intertexto, saepius implexo, ex hyphis flavis vel fulvis, loculis brevibus et longis cylindraceis alternantibus, 5 ad 11 μ longis, 3.5 μ latis, composito; peritheciis numerosis, generatim sterilibus, rotundatis, 76 ad 99 μ diam., setosis sed setis rarissimis, solum circa ostiolum apparentibus et per ostioli regionem sparsis, brevibus, crassis, plus minusve angulatis et ad similitudinem puncti saggitarum accedentibus; ascis sat numerosis, cylindrico-oblongis, 8-sporiis, ad extremum rotundatis, 27 ad 35 μ longis, 11 ad 16 μ latis; aparaphysatis, sporidiis hyalinis, longis cylindraceis, fastigatis, sed ad apicem rotundatis, 3 ad 5-septatis sed generatim 5-septatis, 16 ad 19 μ longis, 3.5 ad 4 μ latis; pycnidiis numerosis, magnitudine valde variis, brevibus et crassis, longis et cylindraceis, flavis vel fuscis, 51 ad 143 μ longis, 12 ad 38 μ latis; pycniosporiis numerosis, hyalinis, ovatis, minutissimis.

The fungus is superficial, rough, sooty, black, amphigenous, although much thicker on the upper surface of the leaf and often covering it; easily detached from the host like a thick sooty layer. Mycelium thick, dematioid, irregularly interweaving, often matlike; the hyphæ composed of short and long cylindrical cells, 5 to 11 μ long, 3.5 μ wide. Perithecia abundant, but mostly sterile, globose, 76 to 99 μ in diameter; setose; setæ very few, occurring only around the border of the ostiole or in its vicinity, short, more or less angular, resembling an arrowhead.

Asci quite abundant, oblong-cylindric, round at the apex, 27 to 35 μ long, 11 to 16 μ wide, 8-spored; paraphyses none. Spores hyaline, long, cylindric rounded at the distal end, tapering toward the other, 3 to 5-septate, usually the latter, 16 to 19 μ long, 3.5 to 4 μ wide. Pycnidia yellow to dark brown, quite abundant, highly variable in size, stout to very long cylindrical, 51 to 143 μ long, 12 to 38 μ wide. Pycniospores numerous, hyaline, oval, very small.

LUZON, Batangas Province, Looc, *Bur. Sci. 22674, M. Ramos and D. Deroy* (type), April 25, 1915, on leaves of *Ficus* sp.

Aithaloderma Syd. is a setose genus the type species of which is *A. clavatisporum* Syd.[5] *A. fici* differs from the type in having much narrower asci and very much smaller spores, with a much higher proportion of 5-septate ones. The pycnidia in *A. fici* are also much shorter and broader.

Aithaloderma setosum (Zimmerman) Boedijn,[6] a Javanese sooty mold, closely resembles the Philippine species in many respects but differs in having hairlike, septate setæ, while those of the species just described are stout and more or less sagittate.

CHAETOTHYRIUM MURIFORMIS sp. nov. Plate 9, figs. 1 to 3; Plate 10, figs. 1 to 5.

Colonia fungosa, superficialis, amphigena sed generatim epiphylla, paene totam superiorem folii superficiem obtegens, tenuem, atram cuticulam facile amovibilem efformans; mycelio dematiaceo, viride cinereo vel atro cinereo, implexo, ex cellulis ovatis cum loculis longis, cylindraceis, intertextis composito, (loculis brevibus 6 ad 14 μ longis, 6 ad 7 μ latis; loculis longis 8 ad 22 μ longis, 3 ad 6 μ latis) ; peritheciis numerosis, sine stilo, globatis, subviridibus vel atro fuscis, ostiolatis, magnitudine variis secundum perithecii aetatem *e. g.* 93 ad 213 μ diam., ostiolo sine margine definito, plus minusve pellucido; asci numerosis, cylindraceis octosporis, aparaphysatis, 58 ad 67 μ longis, 14 ad 20 μ latis; sporidiis muriformis, cum loculis irregularibus, 6- vel 11-septatis, aut per obliquum aut per longitudinem, generatim per longitudinum, dispositis, hyalinis vel roseis vel subflavis 26 ad 37 μ longis, 6.6 ad 19 μ latis; pycnidiis paucis, fulvis, plus minusve ovatis et ad extremum dilatis, ostiolatis, ostiolo ex loculis longis gracilibusque composito, 46 ad 60 μ longis, 26 ad 31 μ latis; pycniosporiis valde numerosis, ovatis, hyalinis, minutissimis.

The fungus produces a thin, sooty black, surface film easily detached from the host, amphigenous, although thicker on the upper surface and often almost covering it. Mycelium dematioid, forming a matlike weft composed mainly of ovoid cells interwoven with long cylindrical ones; short cells 6 to 14 μ long,

[5] Ann. Myc. (1913) 257–258.

[6] Bull. Jard. Bot. Buitenzorg Sér. III 9 (1931) 227–228.

6 to 7 μ wide, long cells 8 to 22 μ long, 3 to 6 μ wide, pale olive-gray to deep grayish in color. Perithecia abundant, not stalked, globular, greenish gray to dark brown, the smallest 93 μ, the largest 213 μ in diameter; ostiole with no definite border, more or less transparent.

Asci numerous, cylindrical, rounded at the apex, 58 to 67 μ long, 14 to 20 μ wide, 8-spored; paraphyses none. Spores muriform with cells dissimilar in size, 6- to 11-septate, hyaline to rose, or approaching pale amber in color, 26 to 37 μ long, 6.6 to 19 μ wide. Pycnidia few, amber-colored, nearly pear-shaped, enlarged at the distal end, 48 to 60 μ long, 26 to 31 μ wide; with an ostiole composed of long, slender cells. Pycniospores very numerous, oval, hyaline, very small.

LUZON, Laguna Province, Los Baños, *Bur. Sci. 65001, J. M. Mendoza and E. Roldan* (type), October 20, 1931, on leaves of *Codiaeum variegatum* (Linn.) Blume.

Petrak[7] after careful study of certain of the Chaetothyriæ reached the conclusion that the genera *Limacinia, Treubiomyces,* and *Paeosaccardinula* should be fused with the genus *Chaetothyrium.*

After a study of *Chaetothyrium javanicum* (Zimm.) Boedijn[8] reached essentially the same conclusion as Petrak but suggested that the generic limits of *Chaetothyrium* should be somewhat extended to properly include the other three. In his studies of the sooty molds the writer[9] has experienced many difficulties among which may be mentioned the frequency with which they intermingle with other fungi, thus rendering it difficult to determine which of the elements belong to the one and which to the other organism. With the species just described the writer found an *Antennellina* associated.

The writer has compared *Chaetothyrium muriformis* with the descriptions of species published under *Phaeosaccardinula, Limacinia, Limacinula, Treubiomyces,* and *Chaetothyrium* and is convinced that it is a well-marked species.

ACKNOWLEDGMENTS

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[7] Ann. Myc. 27 (1929) 380-381.

[8] Bull. Jard. Bot. Buitenzorg. Sér. III 9 (1931) 227-228.

[9] Stevens, F. L., Hawaiian Fungi, Bernice P. Bishop Museum Bull. 19: 52-63; Ann. Myc. 28 (1930) 365-366.

and assisting in the preparation of the manuscript; of Rev. Henry C. Avery, S.J., Ph.D., of the Ateneo de Manila, in translating the English descriptions into Latin; of Dr. G. O. Ocfemia, in charge of the herbarium of the College of Agriculture, University of the Philippines, in loaning the writer specimens of the family Microthyriaceæ and Capnodiaceæ for study and comparisons; and of the Director of the Botanical Garden, Buitenzorg, Java, in loaning specimens of the family Microthyriaceæ to the Bureau of Science for the writer's studies.

ILLUSTRATIONS

PLATE 1. ASTERINA XYLOSMAE SP. NOV.

FIG. 1. Photomicrograph of a fungous colony on the leaf surface, showing perithecia; × 20.
2. Portion of perithecium, with mycelium; × 1431.
3. Ascus, with eight ascospores; × 1431.
4. Two constricted ascospores; × 1431.
5. Mycelium with opposite, 2-celled hyphopodia; × 1431.

PLATE 2. ASTERINA PLECTRONIAE SP. NOV.

FIG. 1. Photomicrograph of a fungous colony on the leaf surface, showing perithecia; × 20.
2. Portion of perithecium, with mycelium; × 1431.
3. Mycelium, with opposite, 1-celled, rough-walled hyphopodia; × 1431.
4. Ascus, with ascospores; × 1431.
5. Ascus, with ascospores, another type; × 1431.
6. Two 2-celled ascospores.

PLATE 3. ASTERINA PLECTRONIAECOLA SP. NOV.

FIG. 1. Photomicrograph of a fungous colony on the leaf surface; × 20.
2. Portion of a perithecium, showing characteristics of perithecial hyphæ; × 1431.
3. Mycelium, with one-celled, lobate hyphopodia; × 1431.
4. Ascus, with ascospores; × 1431.
5. Two warted ascospores; × 1431.

PLATE 4. ASTERINA PHALERIAE SP. NOV.

FIG. 1. Photomicrograph of a fungous colony on the leaf surface; × 20.
2. Portion of a perithecium; × 1431.
3. Mycelium, with one-celled hyphopodia; × 1431.
4. Ascus, with ascospores; × 1431.
5. Three constricted two-celled ascospores; × 1431.

PLATE 5. ASTERINELLA CAPIZENSIS SP. NOV.

FIG. 1. Photomicrograph of a fungous colony on the leaf surface; × 20.
2. Portion of a perithecium; × 1431.
3. Mycelium, without hyphopodia; × 1431.
4. Ascus, with ascospores; × 1431.
5. Three constricted two-celled spores; × 1431.

PLATE 6. ASTEROMYXA SURIGAOENSIS SP. NOV.

FIG. 1. Photomicrograph of a fungous colony on the leaf surface, showing numerous perithecia; × 20.
2. Portion of a perithecium; × 1431.
3. Mycelium, without hyphopodia; × 1431.
4. Ascus, with ascospores; × 1431.
5. Three constricted two-celled ascospores; × 1431.
6. A seta arising from the mycelium; × 1431.
7. Three conidia; × 1431.

PLATE 7. AITHALODERMA FICI SP. NOV.

FIG. 1. Photomicrograph of a fungous colony on the leaf surface; × 20.
2. Upper surface of a leaf entirely covered by a sooty mycelial growth.
3. Lower surface of a leaf with several fungous colonies.

PLATE 8. AITHALODERMA FICI SP. NOV.

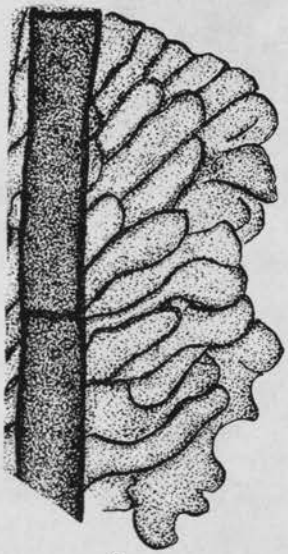
FIG. 1. Perithecium, showing setæ; × 254.
2. Photomicrograph of a perithecium, showing asci and the many-celled ascospores inside.
3. Ascus, with eight ascospores; × 1431.
4. Two ascospores; × 1431.
5. Mycelium; × 1431.
6. A pycnidium arising from the mycelium; × 1431.

PLATE 9. CHAETOTHYRIUM MURIFORMIS SP. NOV.

FIG. 1. Photomicrograph of a fungous colony, showing perithecia; × 20.
2. Lower surface of a leaf, free of fungous growth.
3. Upper surface of a leaf, entirely covered by the fungus.

PLATE 10. CHAETOTHYRIUM MURIFORMIS SP. NOV.

FIG. 1. Portion of a perithecium; × 1431.
2. A young ascus; × 1431.
3. A mature ascus with eight ascospores; × 1431.
4. Four ascospores, showing different types; × 1431.
5. Mycelium; × 1431.
6. A pycnidium with numerous pycnidia; × 1431.



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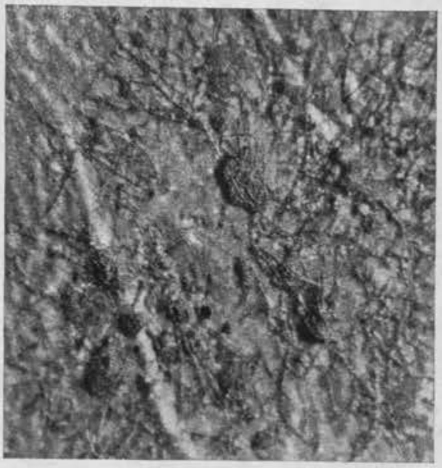

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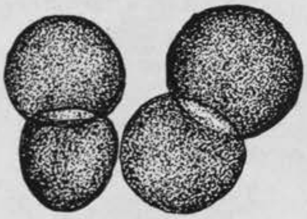

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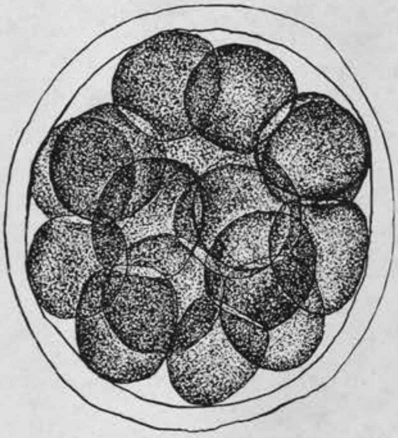

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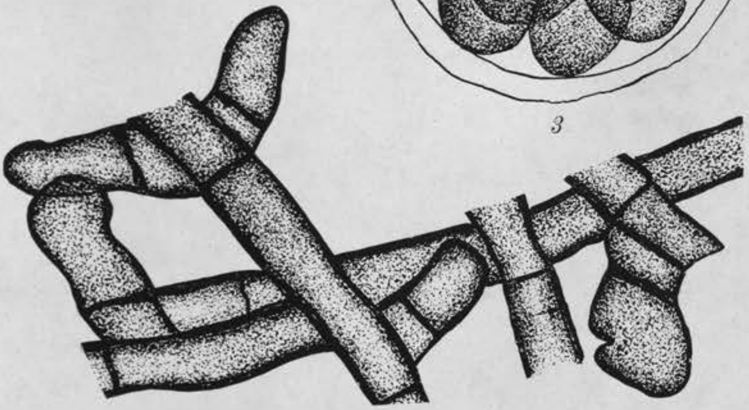

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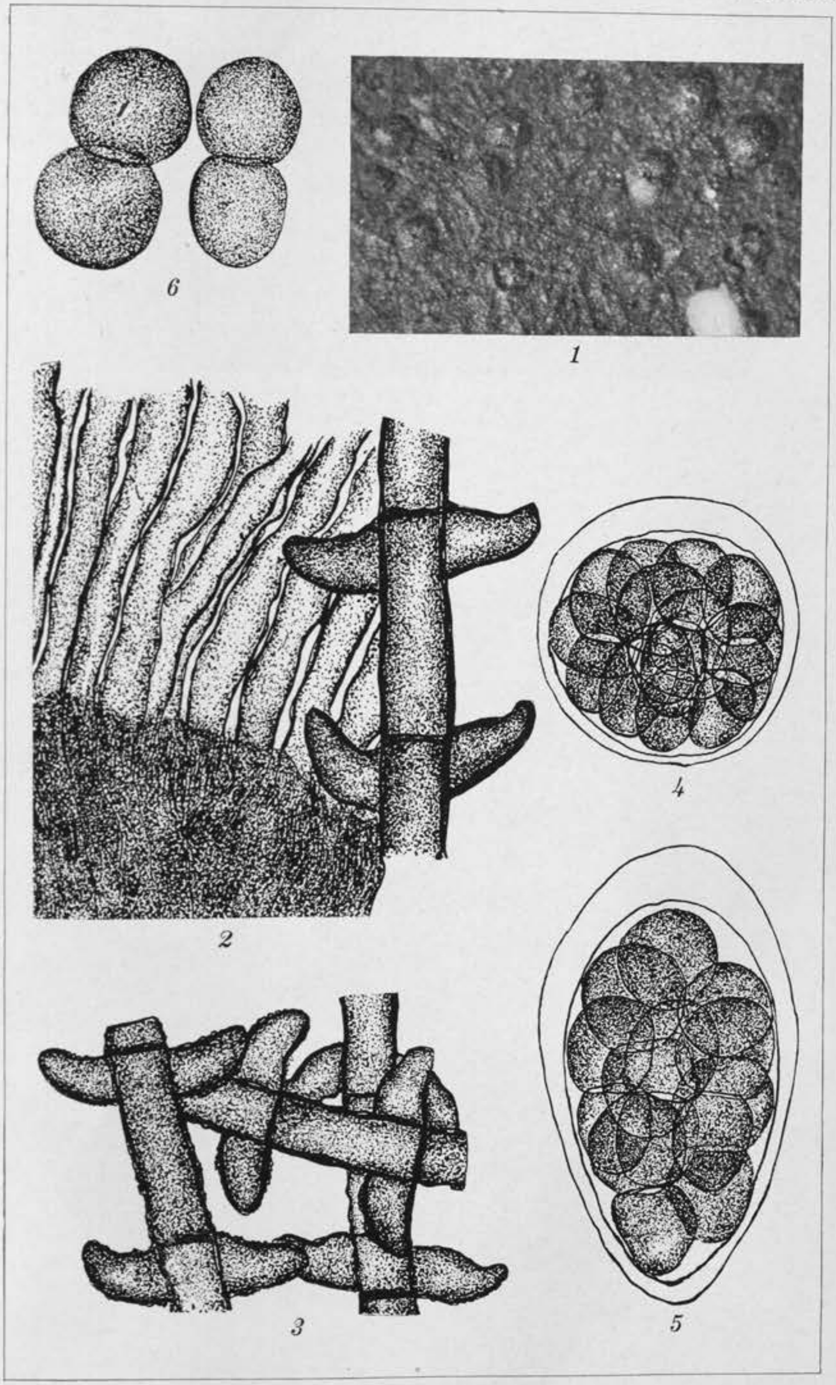
PLATE 1.



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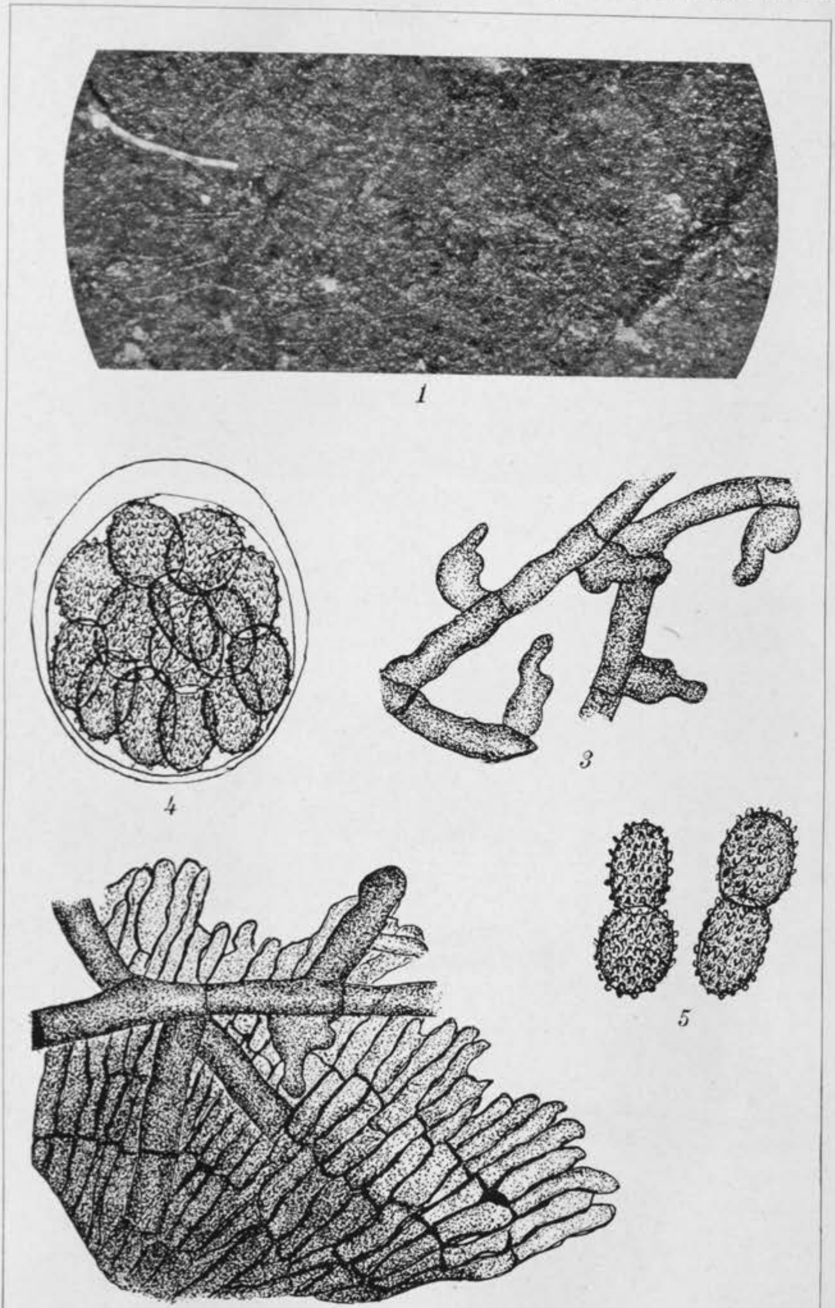

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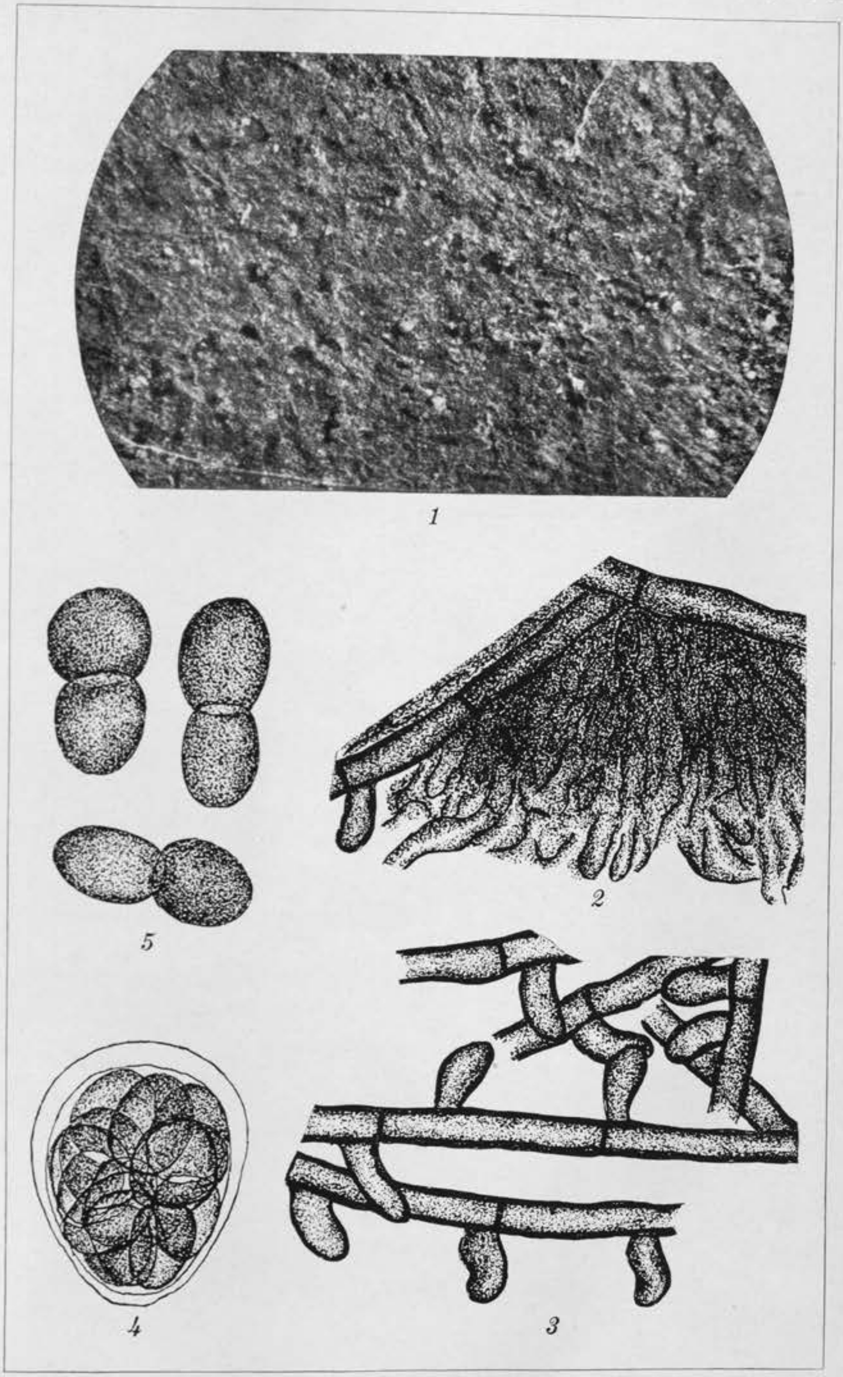

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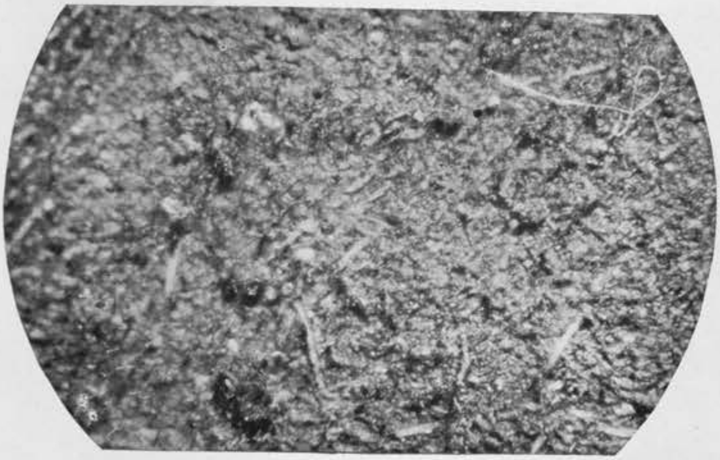

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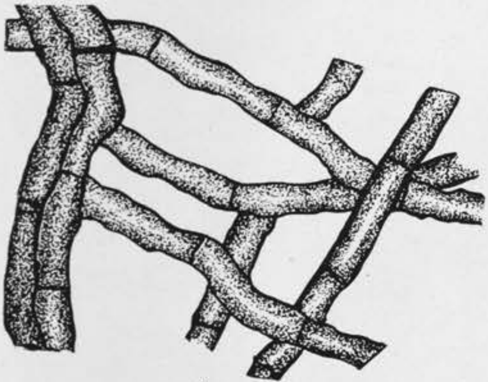

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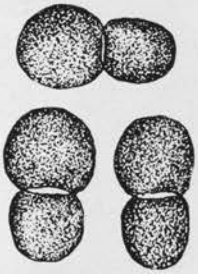

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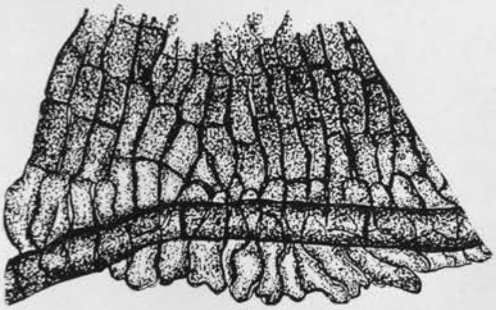

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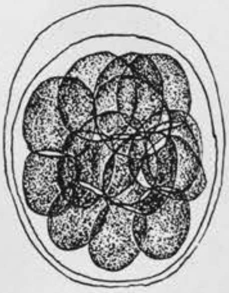

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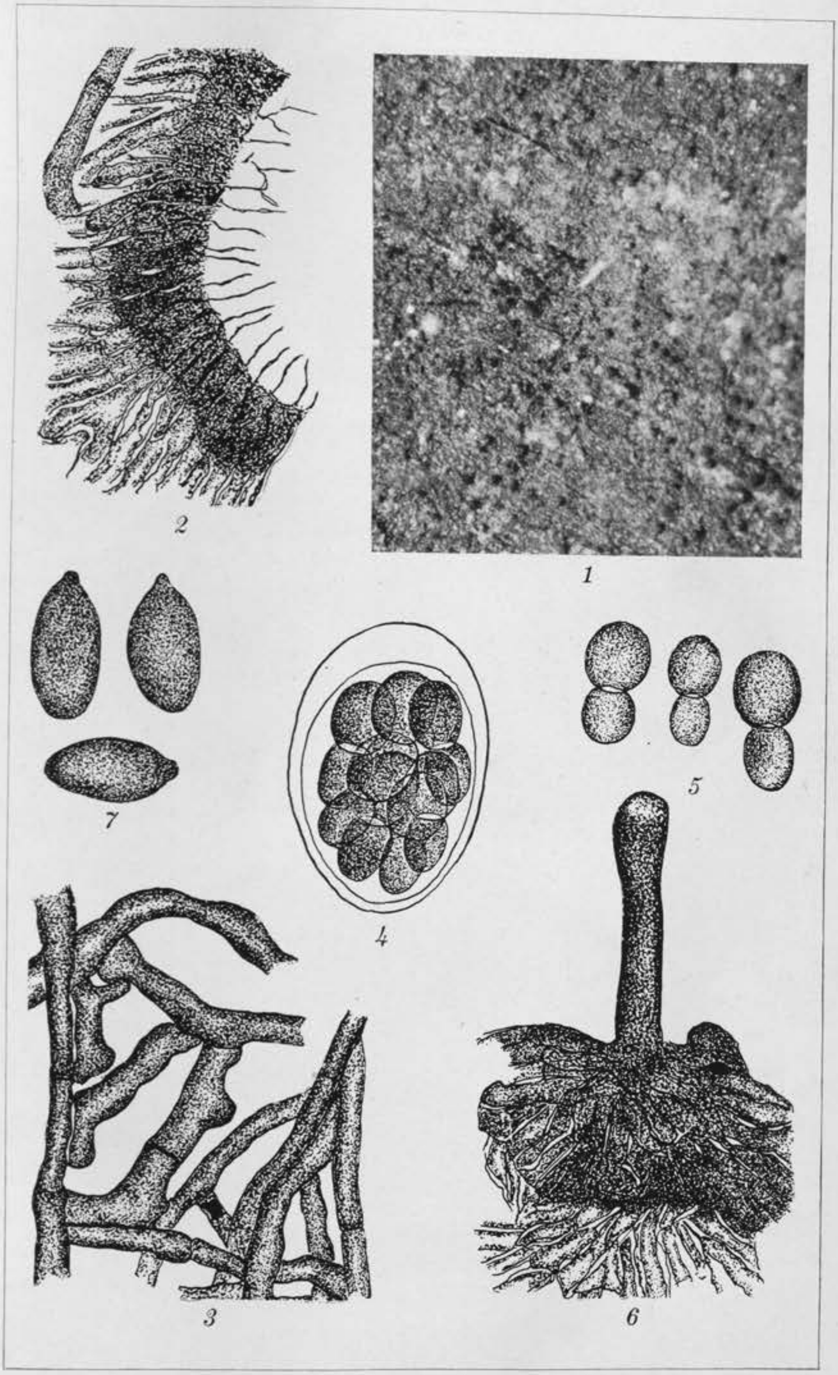

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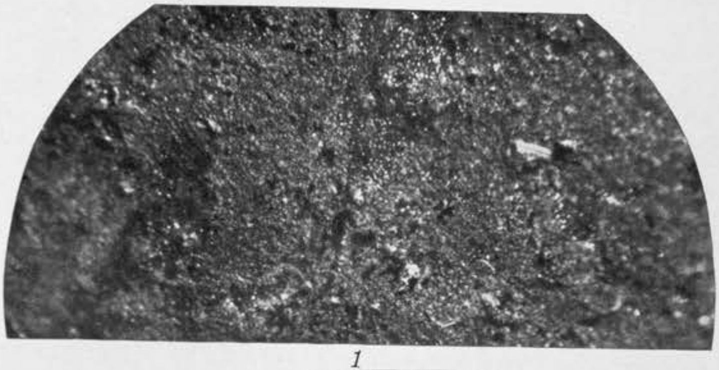

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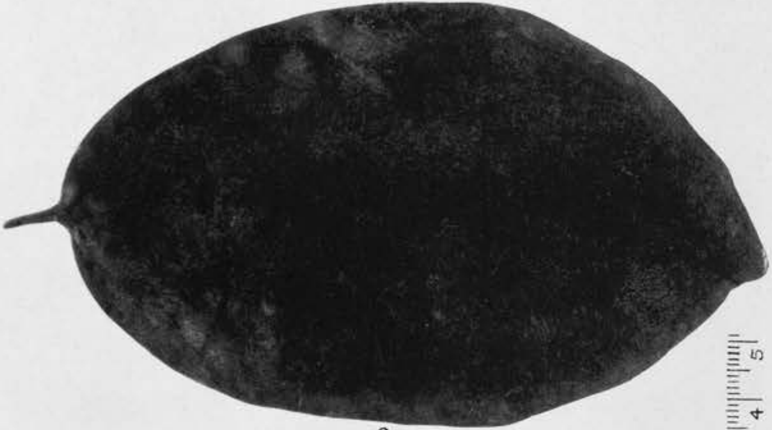

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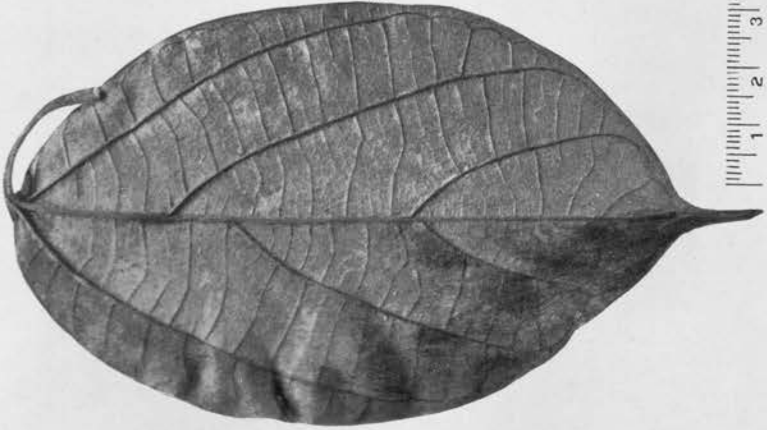

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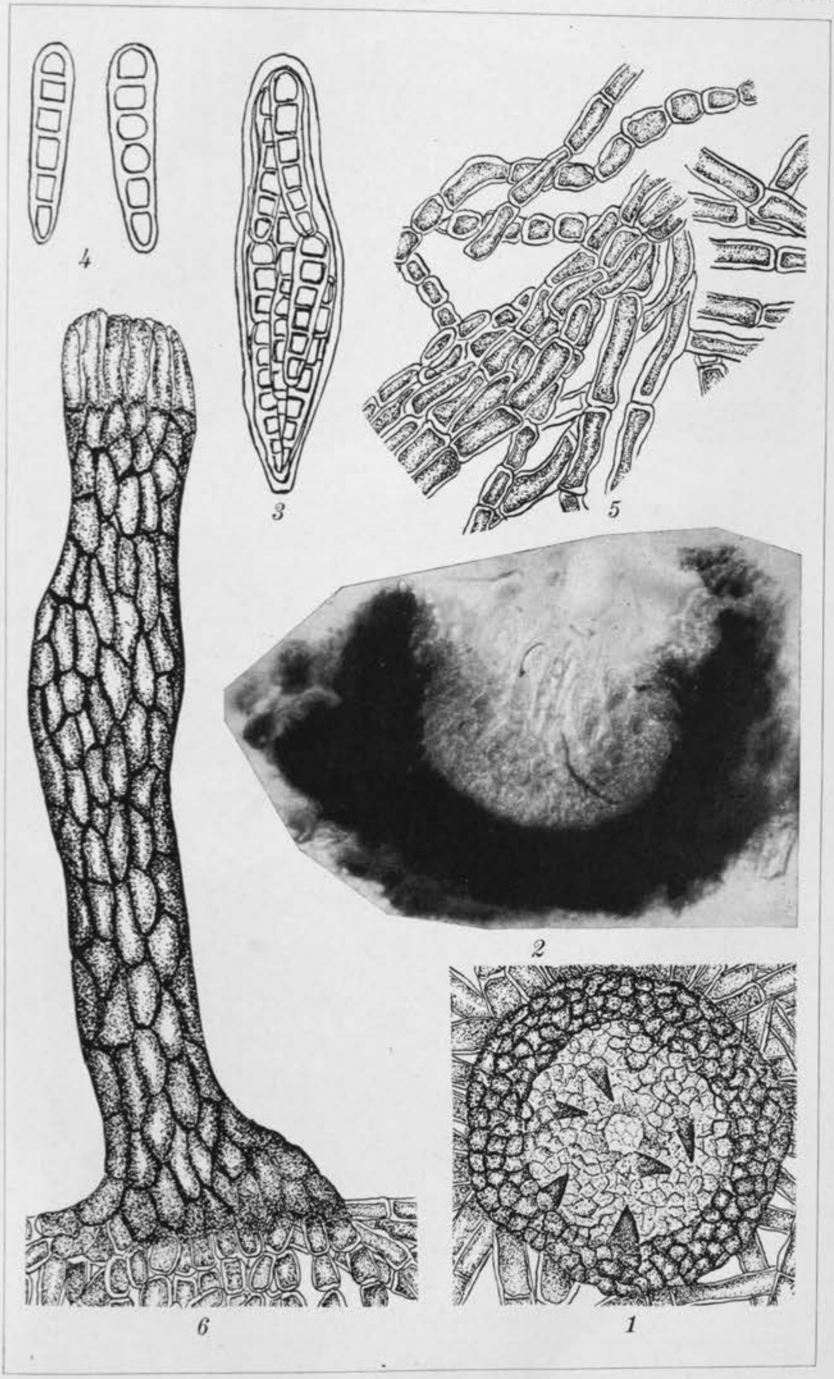

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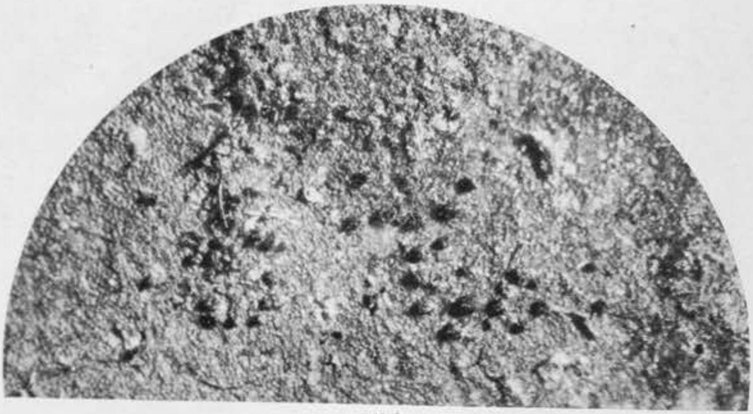

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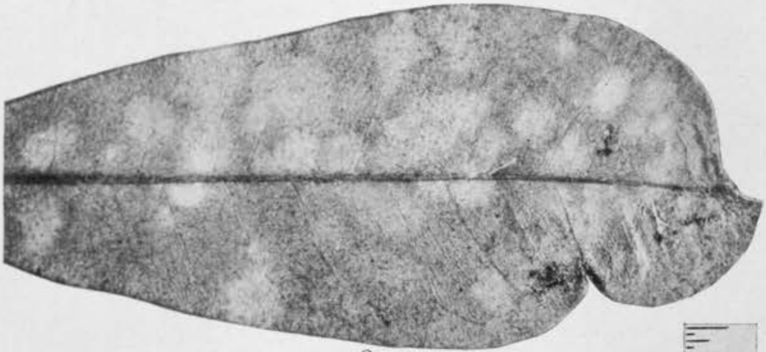

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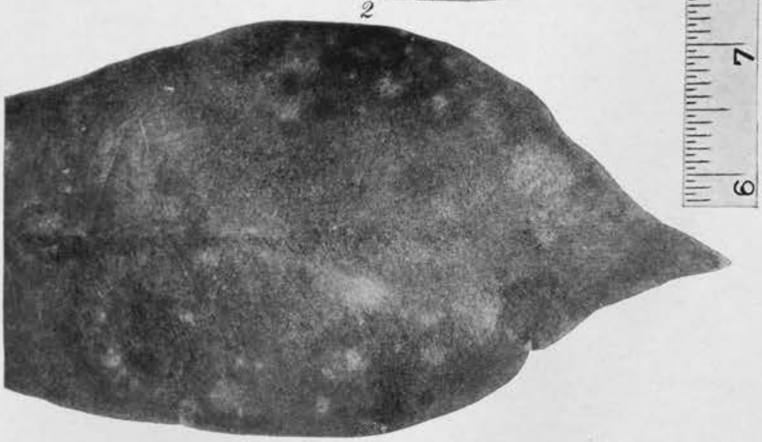

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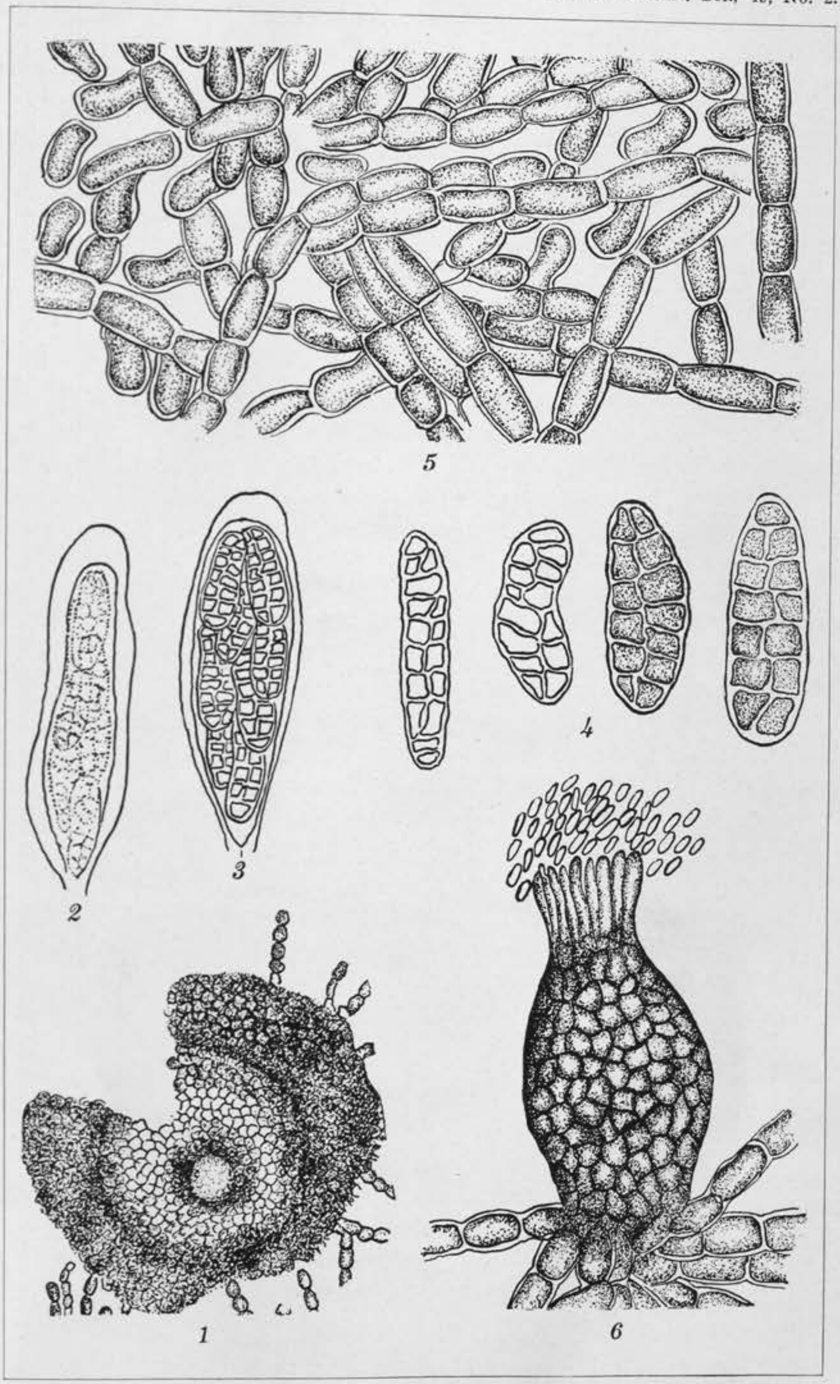

PLATE 10.

NOTES ON THE PHILIPPINE BLACK CORALS

By Leopoldo A. Faustino

Chief Geologist, Bureau of Science, Manila

FIVE PLATES

Several reports have already been made on the Philippine black corals. Seale,[1] calling attention to fine specimens found in Sulu Archipelago, in Davao Gulf, and around Cebu Island and to the large quantities dredged by the U. S. S. *Albatross*, which have been nicknamed "insulated cable wire" by the sailors, referred the specimens to *Antipatharia* sp. Allen,[2] reporting on the chemical analysis, called his specimens *Antipathes abies* (Linn.) Gray. Apparently, the Philippine black corals are not *Antipathes abies* but belong to at least two very distinct and different species. This conclusion is based on examination of identified specimens in the British Museum of Natural History made through the courtesy of Capt. A. K. Totton, keeper of corals, and by comparison of the specimens in the collection of the Bureau of Science with identified specimens, which Dr. Johannes Moser, of the Berlin Museum of Natural History, kindly gave the writer during his visit to Berlin in 1931.

Black corals differ from madreporarian corals in that they are not calcareous or made up entirely of calcium carbonate but are black and with a hornlike skeleton. Among the specimens generally known as Philippine black coral two species are recognized; namely, *Cirripathes anguina* (Dana) and *Cirripathes spiralis* (Linnæus). The general characteristics of the two species as well as the use made of them are set forth in the following paragraphs.

CIRRIPATHES ANGUINA (Dana). Plate 1, figs. 1, 2.

Antipathes anguina Dana, U. S. Expl. Exp. Zoöphytes (1846) 576, pl. 56, figs. 1, 1*a*-1*d*.

Description.—Skeleton hornlike, with a black central axis and a thin cœnenchyma, stalk simple, not branched, flexible when fresh but old specimens brittle and hardly bend, slightly curved or twisted. The longest specimen measures 5 meters, while the largest diameter is 15 centimeters.

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[1] Philip. Journ. Sci. § D 6 (1911) 307.

[2] Philip. Journ. Sci. 41 (1930) 65.

Spines numerous, crowded, generally at right angles to the surface, irregularly distributed though sometimes simulating longitudinal arrangement. Shape bluntly conical, on old specimens generally flattened out.

Localities.—Sulu Sea, Davao Gulf, and around Cebu (Seale); near Balabac Island, Palawan, collected by Antonio D. Alvir; Albay (?); near Bantayan Island, Cebu, collected by Florencio Talavera; Calapan, Mindoro, collected by Wallace Adams.

Distribution.—Western Pacific, Indian Ocean, Red Sea.

Uses.—Black corals were first used in the Philippines for making canes for which they are particularly adapted by reason of their size and shape. The material is easily worked into any desired shape when fresh, but old specimens are brittle and can be bent only with difficulty and only after immersion in warm salt solution. Sometimes the specimens are kept in water for a month or so before work is begun on them. Philippine black coral takes a beautiful jet-black polish and this quality is taken advantage of in the manufacture of fancy jewelry. The articles shown in the illustrations are manufactured by H. E. Heacock Co., Manila. Both this firm and Florencio Viray, 1666 Juan Luna Street, Manila, who are the largest manufacturers of black-coral jewelry in the Philippines, very kindly permitted the examination of the raw materials and the finished products in their shops.

CIRRIPATHES SPIRALIS (Linnæus). Plate 4, fig. 1.

> *Eucirripathes spiralis* (Blainv.) v. PESCH, Antipatharia Siboga Exped. (1914) 158 with several text figures.

Description.—The following description is based on a single specimen in the Bureau of Science, collected by Florencio Talavera in Jolo Channel, Sulu Archipelago.

Specimen flexible and spirally twisted. Coils rather uniform, varying in diameter from 2 centimeters near the base, where it has been snapped off, to 3 and 4 centimeters in the middle of the section. Diameter of the stalk at the base 4 millimeters, gradually diminishing toward the top, where it measures 1 millimeter. Total length of the specimen, not allowing for the spirals, 56 centimeters.

Spines at right angles to the surface, comparatively much longer than in the preceding species, not as numerous or as closely crowded, generally arranged in longitudinal rows, cylindrical in shape.

Locality.—Jolo Channel, Sulu Archipelago.

Distribution.—Western Pacific, Indian Ocean, Mediterranean, West Indies.

Uses.—This is the species that furnishes most of the material for making earrings and similar objects.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Cirripathes anguina* (Dana); thin transverse section; photomicrograph, × 10.
2. *Cirripathes anguina* (Dana); pieces of main stem.
3. *Cirripathes spiralis* (Linnæus); × ⅓.

PLATE 2

Bracelets, made by H. E. Heacock Co., from *Cirripathes anguina* (Dana). (Courtesy of H. E. Heacock Co.)

PLATE 3

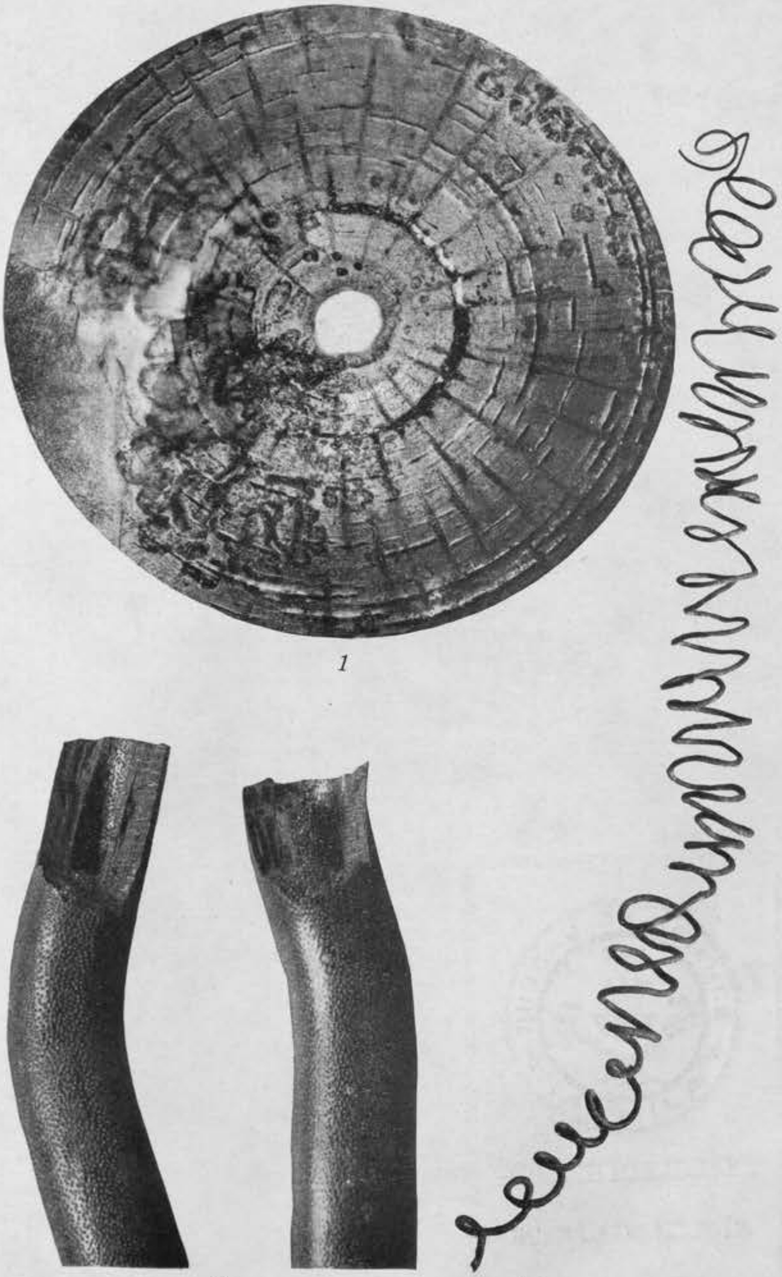
Cigar and cigarette holders, made by H. E. Heacock Co., from *Cirripathes anguina* (Dana). (Courtesy of H. E. Heacock Co.)

PLATE 4

FIGS. 1 and 2. Earrings, made by H. E. Heacock Co., from black corals. (Courtesy of H. E. Heacock Co.)
3 to 6. Earrings, made by H. E. Heacock Co., from *Cirripathes spiralis* (Linnæus). (Courtesy of H. E. Heacock Co.)

PLATE 5

FIG. 1. Finger rings, made by H. E. Heacock Co., from *Cirripathes anguina* (Dana). (Courtesy of H. E. Heacock Co.)
2. Cuff links and scarf pins, made from *Cirripathes anguina* (Dana). (Courtesy of H. E. Heacock Co.)



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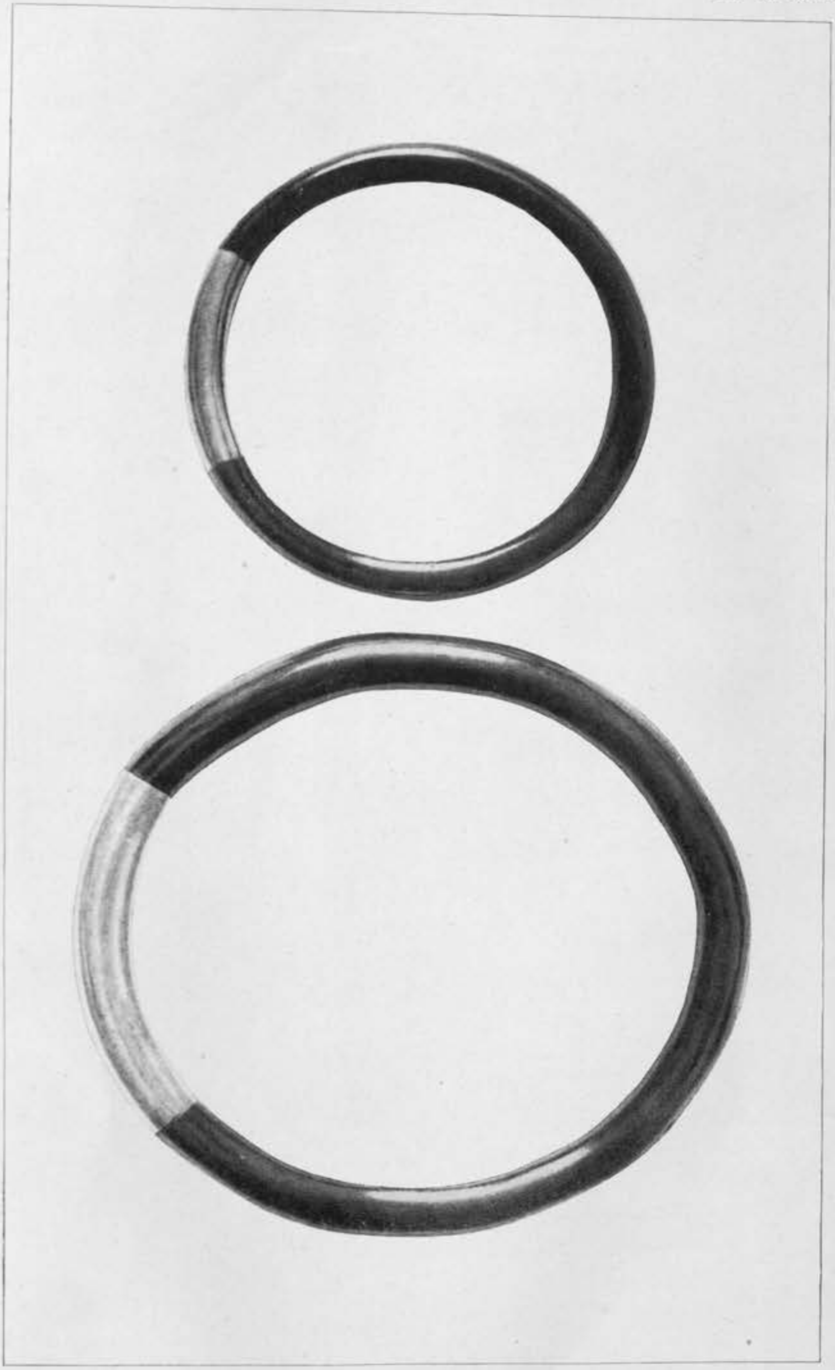

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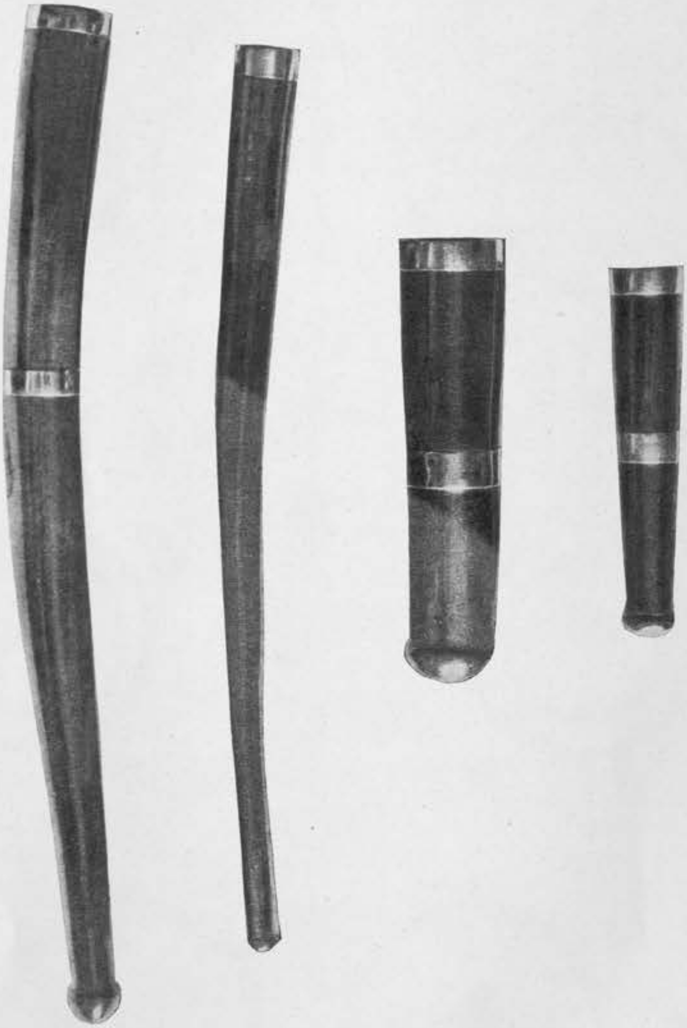

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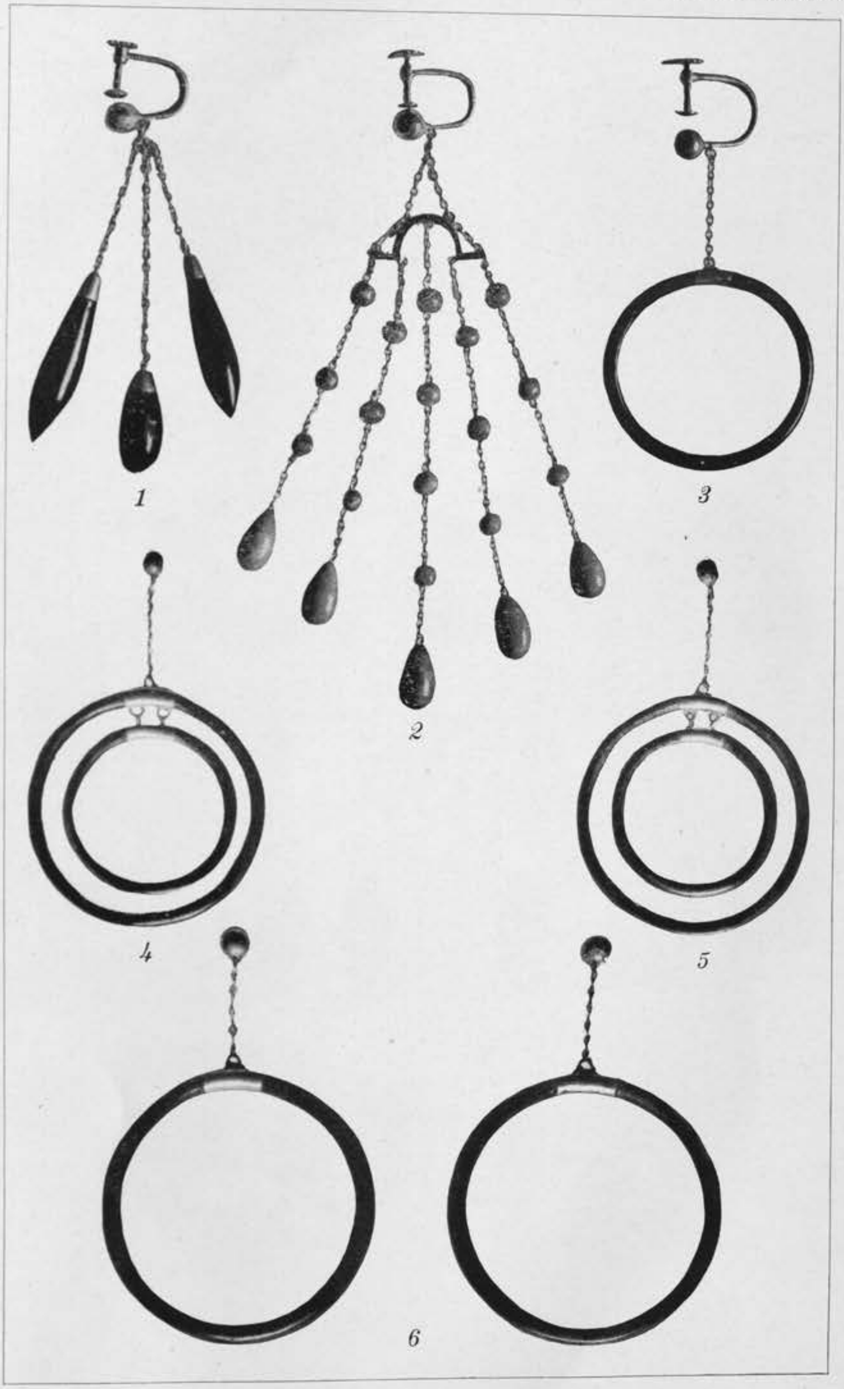

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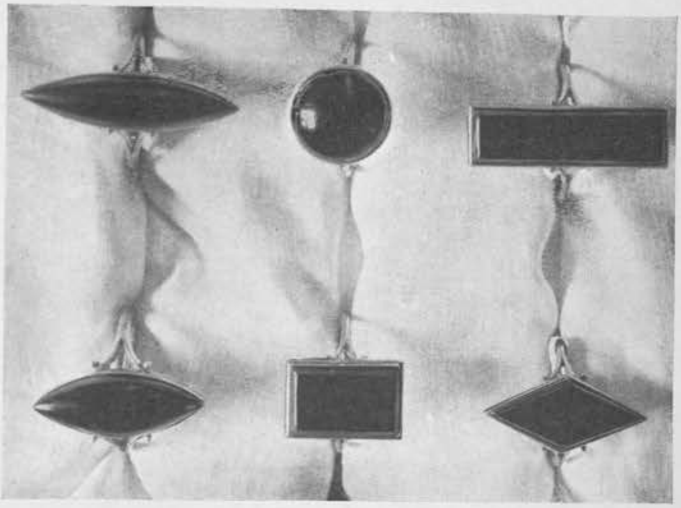

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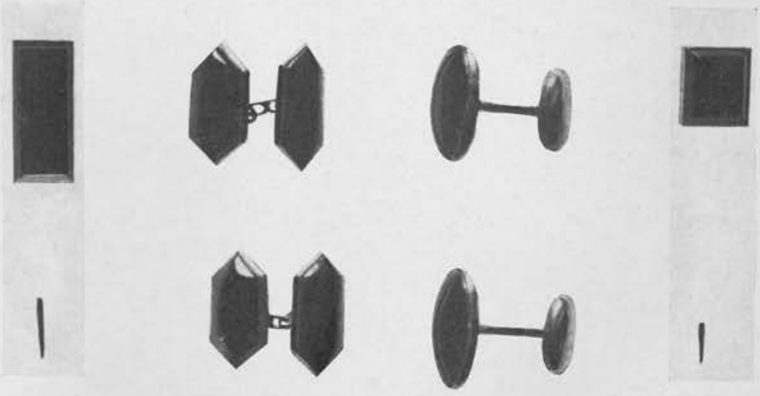

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PLATE 5.

THE DEVELOPMENT OF KARST TOPOGRAPHY IN THE PHILIPPINE ISLANDS

By LEOPOLDO A. FAUSTINO

Chief Geologist, Bureau of Science, Manila

TWO PLATES AND ONE TEXT FIGURE

The characteristic features of karst topography are swallow holes and "karst funnel" or doline, and the regions generally referred to for landscapes of this type are those on the western side of the Balkan Peninsula, in southern France, in the German Jura, and other regions in Europe. At one of the scientific meetings of the Fourth Pacific Science Congress in Java (1929) karst topography in the Tropics was a subject of discussion.[1] Blondel presented his observations in a paper entitled "Karst Phenomena in French Indochina," and P. J. B. van Kessel gave an account of the karst region of the "Duizend Gebergte" (Goenoeng Sewoe, Thousand Hills) in central Java. The present paper embodies the remarks made by the writer regarding the development of karst topography in the Philippine Islands.

Literature on karst formation in tropical regions is not lacking. Hubbard[2] in describing the *pepino* hills of the Lares District, Puerto Rico, came to the conclusion that they "are the byproduct of extensive underground solution and extremely rapid surface solution, combined with the other necessary factors, lithologic and climatic," and that *pepino* hills might be developed anywhere in the tropical zone.[3]

The first requisite to form karst topography is a limestone or calcareous formation. It should be remembered, however, that not all limestone or calcareous formation will form karst topography. Limestone or calcareous formations are of general distribution in the Philippine Islands and are encountered not only along the coast in narrow strips and at high elevations in patches but also in the central regions and occupying extensive areas. The best development of karst topography in the Philippine Islands is in central Bohol (one of the larger islands of the Visayan group) in the vicinity of Carmen. It presents all the characteristic topographic features of Goenoeng Sewoe, Thousand Hills of central Java, which I had the pleasure and the privilege of seeing during one of the excursions of the Fourth Pacific Science Congress in 1929. The Bohol hills will be referred to in this paper as the Carmen Thousand Hills.

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[1] Proc. Fourth Pac. Sci. Congress 1 (1930) 282.

[2] Scientific Survey of Porto Rico and the Virgin Islands 2 pt. 1 (1923) 93.

[3] Also Salomon, W., Karrenfelder in Warmem Klime, Centr. f. Min. 1926 B. 529–30 (1926), unfortunately not available at the time in the Bureau of Science library.

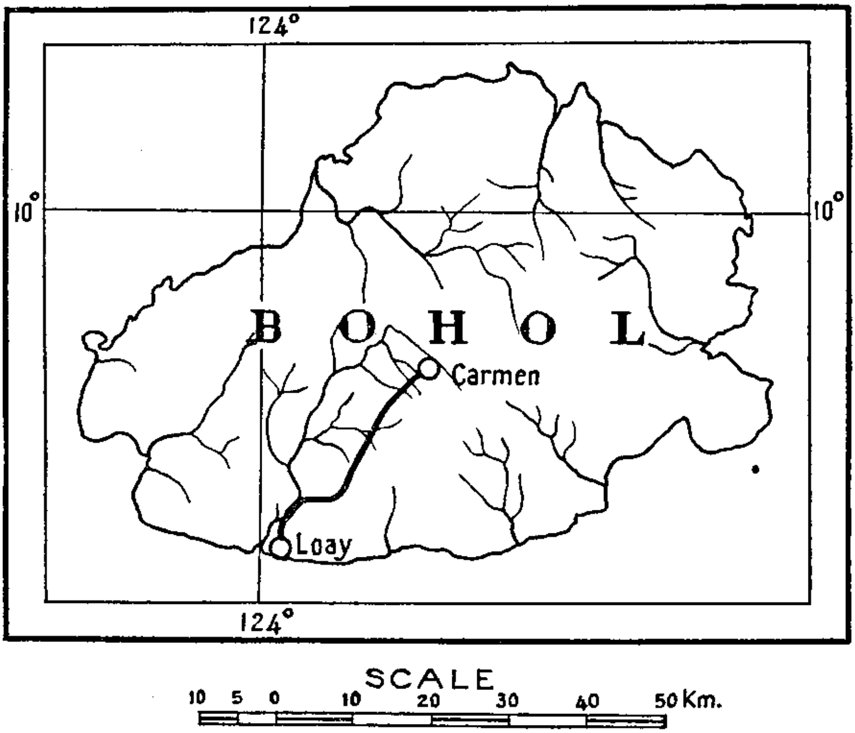

FIG. 1. Bohol Island.

The Carmen Thousand Hills were seen by Warmen D Smith,[1] who described them as a "remarkable series of 'haycock' hills (hundreds of them) in the central part, in the vicinity of Carmen, all alike, having the appearance of a small archipelago of small limestone islands raised some 700 meters," [2] but who offered no explanation. Doctor Dickerson[8] was of the opinion that "the rounded hills, which rise above the general level of this terrace, probably represent a series of stacks that have been rounded by erosion since the general region was uplifted." My own introduction to this very interesting topography was in March, 1929, when the Director of the Bureau of Science sent me to Loay in southern Bohol to investigate a crack in the ground which was "becoming wider and deeper from time to time." The crack was described by Mr. Fidel Bacol, municipal president of Loay, in his letter to the Department of Agriculture and Natural Resources as follows:

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[1] Geology and Min. Res. P. I. Bur. Sci. Pub. 19 (1925) 195.

[2] Mr. Emilio Buenaventura, district engineer of Bohol, estimated the summit of the hills as 400 meters above sea level, in a personal communication to the writer.

> I have the honor to report to this Department the following occurrence:
>
> 1. That Tayong is a barrio along the coast, at the eastern side of the town of Loay, Province of Bohol, at a distance of seven kilometers from the municipal building of the Municipality of Loay, with a population of approximately three hundred-fifty souls living distributively. The area of this barrio is about two square kilometers. It is hilly and the upper part is a place of almost solid rocks.
>
> 2. That a year ago the upper part of this barrio at a distance of about one and one third kilometers from the coast, began to crack in a linear form from east to west. The cracking is rapidly progressing, thus making now a length of about a kilometer. The crack is becoming wider and deeper from time to time. Herewith are sent two views of the middle part of the crack.
>
> 3. That at present the people of this barrio fear the sign of rapid progress of the crack, so that some of them are now entertaining the idea of deserting the place concerned.
>
> For certainty and safety of lives and property, I have the honor to request the Honorable Secretary of Agriculture and Natural Resources to send as early as possible an expert for physical observation and examination of the place concerned.

The results of this investigation and of the following field trip to Carmen in north-central Bohol form the basis of this report.

TOPOGRAPHY OF THE CARMEN THOUSAND HILLS

The Carmen Thousand Hills cover an area in central Bohol in the vicinity of Carmen of approximately 100 square kilometers. The hills are roughly conical or mound-shaped, and as far as could be ascertained at the time of my visit are distributed over the area with an irregular alignment. With a topographic map or an airplane photograph some alignment may be deciphered. Sometimes the bases of adjoining hills joined each other forming U-shaped troughs. At other times there are, however, wide open spaces between the hills. Mr. Emilio Buenaventura, district engineer of Bohol, estimated the average height of these hills as approximately 30 meters and their mean diameter at the base as about 65 meters. When first seen from a distance they present an array of great mounds, like stacks of palay, as if the whole region had just finished a big harvest and all the palay were heaped on both sides of the road. The hills are so numerous that the name Carmen Thousand Hills is fairly descriptive. As the region is covered mainly with shrub and grass vegetation and there are few trees, the sight is imposing and one that impresses the visitor long after he has seen the place. The summits of these conical hills rise to about the same elevation and from the top of one of them it is not difficult to discern the old plateau surface or elevated marine terrace which once occupied the whole region. The slopes of the hills are flowing lines and the region has already reached late maturity, perhaps early old age.

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[8] Tertiary Paleogeography of the Philippines, Philip. Journ. Sci. 25 (1924) 49. Explanatory note Plate 1, fig. 2.

ORIGIN OF THE CARMEN THOUSAND HILLS

The origin of these hills may best be deciphered by reference to the origin of the crack at the barrio of Tayong, Loay. The crack first appeared on the top of a hill on one side of which a stream has already deepened its channel sufficiently low to throw out of adjustment its underground tributary passing through the hill. As this underground tributary began to lower its channel caverns started to form. At the time that the cracks appeared on the surface the caverns had grown sufficiently large and the roof sufficiently weak to permit a collapse. The result was the formation of a long collapse sink which the President of Loay referred to as the crack extending east and west.

Upon examination the walls of the crack were found to be calcareous formation with bits and triturated madreporarian corals and shells. Few good fossil specimens were found. The formation is distinctly porous and one that will permit free underground water circulation sufficiently rapid to form caverns. It does not show signs of bedding but apparently is just a mass of calcareous materials.

The Carmen Thousand Hills are composed of similar calcareous materials, if the quarry of the Bureau of Public Works for road materials on one of the hills near the road could be taken as a criterion. The summit of the hills is approximately 400 meters above sea level. In other words, the original land surface of the elevated plateau or marine terrace was sufficiently high for the formation of sink holes and swallows by descending meteoric waters. As sinks began to be numerous and underground drainage well developed numerous caverns were formed and collapsed. The portions that remained intact are now the summit of the hills, while the valley bottoms are the channels of the underground streams laid bare by collapse. Bohol, at least this particular region, has remained stationary sufficiently long for the formation of the peculiar topographic features. The climate of Bohol, with no strongly pronounced maximum rain period and no dry season, and the apparently uniform lithologic character of the calcareous formation both helped in the development of these interesting topographic details, which are found only in Bohol. At least, my ten years field work in different parts of the islands has not revealed anything similar.

While calcareous or limestone formations are very widely distributed throughout the Archipelago, no area has produced topographic features similar to the Carmen Thousand Hills. The northern portion of Cebu Island is a recently elevated coral reef, not very high above sea level, and has but incipient solution sinks and slightly developed underground drainage. The hard, fine-grained limestone in different parts of Luzon forms cliffs and sometimes needles as at Sagada, Mountain Province, rather than conical hills. It is, therefore, the conclusion of the writer that karst topography developed in Bohol Island because of a combination of circumstances including rock formation, elevation, chemical and mechanical erosion, climatic and other factors and that these factors have been permitted to work their natural course without interruption for a sufficiently long period of time to form the Carmen Thousand Hills.

ILLUSTRATIONS

PLATE 1

THE COLLAPSED SINK AT BARRIO TAYONG, LOAY, BOHOL

FIG. 1. Inhabitants of the barrio gathered at the widest portion. (Photograph sent by Fidel Bacol.)
2. Another view of the collapsed sink.
3. Cracks that form part of the collapsed sink.

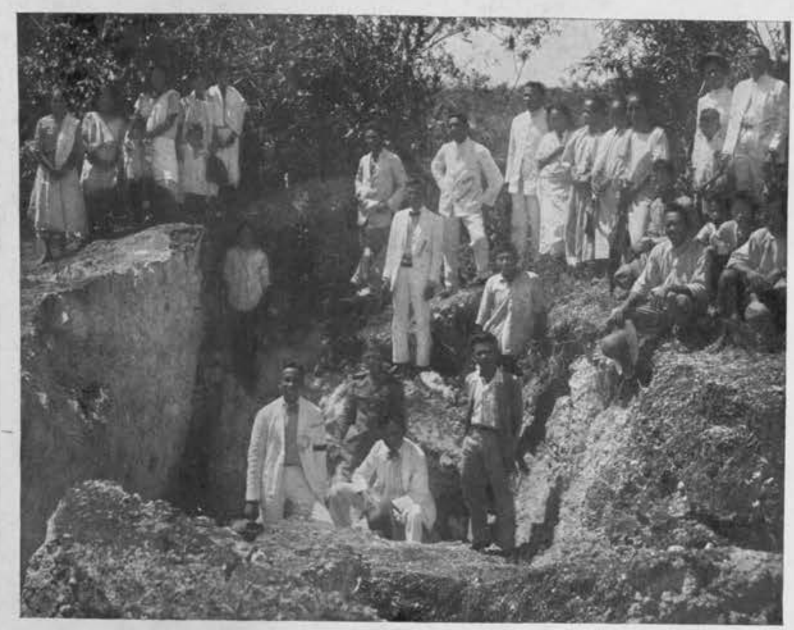
PLATE 2

THE CARMEN THOUSAND HILLS

FIGS. 1 and 2. General views of the district showing arrangement and general appearance of the hills from a distance.
FIG. 3. A close-up view of one of the hills showing vegetation.

TEXT FIGURE

FIG. 1. Map of Bohol Island.



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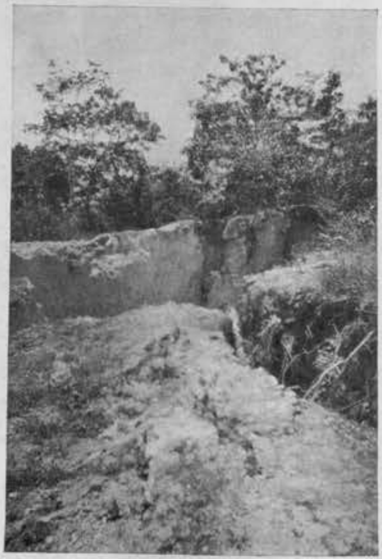

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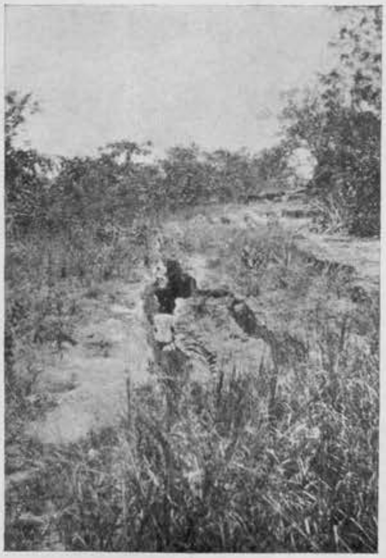

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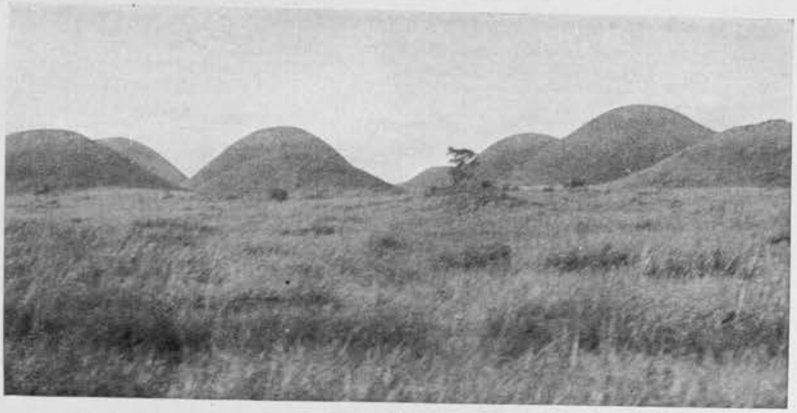

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PLATE 2. VIEWS OF CARMEN THOUSAND HILLS.

EXPERIMENTS WITH VARIOUS TOXIC SUBSTANCES PARTIALLY ADSORBED ON CHARCOAL AS AN ANOPHELES LARVICIDE

LARVICIDE STUDIES, IV[1]

By AUGUSTUS P. WEST

Of the Bureau of Science, Manila

and

PAUL F. RUSSELL

Of the International Health Division of the Rockefeller Foundation

ONE PLATE

In previous papers[2] some experiments were reported in which Paris green and other arsenicals mixed with charcoal or partially adsorbed on it were used as an anopheles larvicide. Further studies have been undertaken to test the larvicidal properties of reputedly insecticidal substances partially adsorbed on charcoal. The results are recorded in this paper.

EXPERIMENTAL PROCEDURE

The technic used in these experiments was the same as explained in our previous papers. *Anopheles subpictus* and *A. hyrcanus* var. *sinensis* larvæ in third and fourth stages of development were used. Enamel pans were filled with artesian water so that they had a surface area of 532 square centimeters and a depth of 5 centimeters. Larvæ were not pronounced dead until all motion had ceased. They were then removed to separate beakers of water to guard against possible mistakes in diagnosis or counting. The amount of mixture used was less per area than that advocated for field use. Control pans were used with the same number and species of larvæ, the same amount of water and external influences. The larvæ had no difficulty in filling their digestive tracts with the treated charcoal and after about one to two hours there was a continuous flow of charcoal through the gut of each larva for twenty-four hours (and in some cases for seventy-two hours).

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[1] These studies were undertaken by the divisions of organic chemistry and of malaria investigations, Bureau of Science. The division of malaria investigations is coöperatively supported by the bureau and by the International Health Division of the Rockefeller Foundation.

[2] Russell, P. F., and A. P. West, Philip. Journ. Sci. 48 (1932) 291. West, A. P., and P. F. Russell, Philip. Journ. Sci. 48 (1932) 545. Russell, P. F., and A. P. West, Philip. Journ. Sci. 49 (1932) 97.

RESULTS

The results of these experiments have been almost entirely negative but are of considerable use in comparison and contrast to the tests reported in our previous papers. These tests help in the attempt to evaluate the usefulness of certain insecticides as anopheles larvicides.

It was surprising that such potent substances as nickel chromate (test 36) and barium chloride (test 115), when combined with charcoal, were without effect on anopheles larvæ. No absorption whatever apparently took place in the gut of the larvæ. Yet barium chloride has a high reputation as an insecticide and is so poisonous to man that 4 to 5 grams will prove fatal. Bourcart[3] states that this salt, when absorbed with food, kills insects as rapidly as arsenical preparations. Paris green and arsenic trioxide are difficultly soluble in water and are only partially adsorbed by charcoal. Barium chloride is very soluble in water and is adsorbed readily by charcoal. Possibly the barium chloride clings to the charcoal more tenaciously than Paris green and therefore is not released in the gut of the larva as are the arsenicals when similarly introduced on charcoal. In a 3 per cent concentration (test 115) it was wholly impotent against anopheles larvæ.

Pyrethrum powder partially adsorbed on charcoal in 1 and 3 per cent concentrations proved to be relatively ineffective. This substance, obtained from the powdered flower heads of *Chrysanthemum cinerariaefolium* (Trev.) has long been recognized as an insecticide,[4] but in these experiments using a low concentration, because it would be economically unfeasible in practice in greater amounts, the pyrethrum seems to have no value as an anopheles larvicide. Two types of extracts were used, one the usual kerosene preparation and the other a chloroform extraction.

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[3] Bourcart, E., Insecticides, Fungicides, and Weedkillers (1913) 138.

[4] Bourcart, E., Insecticides, Fungicides, and Weedkillers (1913) 378. McIndoo, N. E., and A. F. Lievers, U. S. Dept. Agr. Bull. 1201 (1924) 6 and 31.

Nicotine is another vegetable product which has found a usefulness as an insecticide but which in these experiments has been disappointing (test 56). In this case a water extract of mature tobacco was used; the exact concentration on the charcoal was not determined.

So, too, tannic acid (tests 59 and 60) are nitre cake (test 48) were ineffective. The later is acid sodium sulphate, or sodium bisulphate, a by-product in the manufacture of nitric acid. It has been suggested from time to time as a larvicide. Metz,[5] for example, reported it to be fairly efficient. Eckstein [6] tried it with poor results against larvæ of *Culex pipiens.* Allen,[7] however, found that it destroyed larvæ of *Aëdes solicitous* in three hours. In our experiment (test 48) an 8 per cent concentration failed to kill anopheles larvæ.

Rotenone (test 112), in the low concentration of 0.4 per cent, killed about one-third of the larvæ in twenty-four hours. This substance is the insecticidal principle of the root of *Derris elliptica* and has been advocated for use against a variety of insects, including mosquitoes. On charcoal it does not appear to have any greater potency than Paris green which is less expensive.

SUMMARY

Certain heavy metallic poisons and some miscellaneous nonarsenical substances partially adsorbed on powdered charcoal have been tested for larvicidal properties against anopheles larvæ but none was found to be as effective as Paris green.

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[5] Metz, C. W., U. S. Pub. Health Rep. 34 (1919) 167.
[6] Eckstein, F., Zeits. Angew. Entom. Berlin 6 (1920) 338.
[7] Allen, A. H., U. S. Naval Med. Bull. 16 (1922) 1.

TABLE 1.—*Larvicidal effect of some reputedly insecticidal substances partially adsorbed on charcoal.*

Test No.	Substance used.	Concentration.	Number of larvæ used.	Percentage of dead larvæ in time periods (hours). Cumulative totals.										Weight of larvicide.
				1.25	2.5	3	4	5	6	7	24	48	72	
		Per cent.												*g.*
41	Control	------	50	0	0	0	0	0	0	0	4	4	------	------
35	Nickel carbonate	3.0	50	0	0	0	0	0	0	------	2	4	4	0.30
	Lime	0.5												
36	Nickel chromate	3.0	50	0	0	0	0	0	0	------	2	2	2	0.13
	Lime	0.5												
37	Nickel oxalate	3.0	50	0	0	0	0	0	0	------	0	0	0	0.13
	Lime	0.5												
61	Antimony trioxide	3.0	10	0	0	0	0	0	0	------	0	0	0	(b)
55	do	3.0	50	0	0	0	0	0	0	------	0	------	------	0.13
	Lime	0.5												
9	Copper carbonate	4.0	50	0	0	0	0	4	4	------	42	------	------	0.13
	Oxalic acid	2.0												
34	Copper oxalate	3.0	50	0	0	0	0	0	0	------	0	2	2	0.13
	Lime	0.5												
32	Barium carbonate	3.0	50	0	0	0	0	0	0	------	0	0	2	0.13
	Lime	0.5												
115	Barium chloride	3.0	50	0	0	0	0	0	6	------	6	------	------	0.10
33	Barium chromate	3.0	50	0	0	0	0	0	0	------	0	0	2	0.13
	Lime	0.5												
45	Barium oxalate	3.0	50	0	0	0	0	0	0	------	0	------	------	0.13
	Lime	0.5												
44	Calcium oxalate	3.0	50	0	0	0	0	0	2	------	4	------	------	0.13
	Lime	0.5												
30	Oxalic acid	10.0	50	[a]2	2	2	2	2	2	------	2	2	4	0.13
48	Nitre cake	8.0	50	0	0	2	2	2	2	------	2	------	------	0.13
49	Pyrethrum (kerosene extract)	3.0	50	0	0	2	4	8	8	------	12	------	------	0.13

162	Pyrethrum (chloroform extract)	1.0	50	0	0	0	0	0	0	------	0	------	------	0.10
54	Cinnamic acid	3.0	50	0	0	0	0	0	0	------	0	------	------	0.13
56	Nicotine	[c]0.5	50	0	0	0	0	0	0	------	0	------	------	0.13
59	Tannic acid	3.0	10	0	0	0	0	0	0	------	0	0	0	([b])
	Lime	0.5												
60	Tannic acid	3.0	10	0	0	0	0	0	0	------	0	0	0	([b])
112	Rotenone	0.4	50	0	0	2	2	2	2	2	34	------	------	0.10
157	(P) Nitro phenol	1.0	50	0	0	0	0	0	0	6	6	------	------	0.10

[a] Tests were made at intervals of 15, 30, 45, 60, 75, 90, and 105 minutes. In each case negative results were obtained except in test 30 at the 75 minute (1.25 hour) period which gave two dead larvæ.

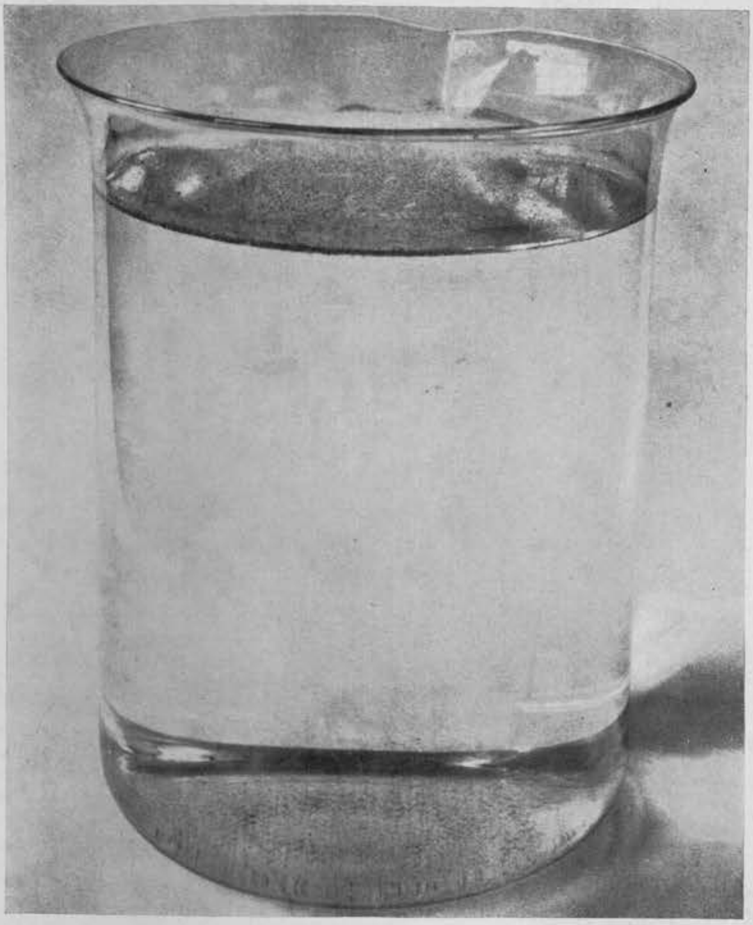
[b] Enough to cover surface.

[c] Concentration estimated.

ILLUSTRATION

PLATE 1

FIG. 1. Charcoal on water.
2. Mosquito's gut containing charcoal.



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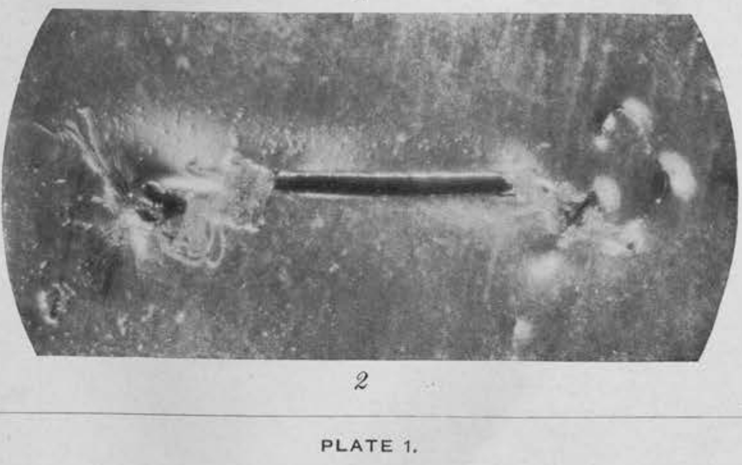

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PLATE 1.

ANOPHELES MINIMUS LARVÆ FROM WELLS IN LAGUNA PROVINCE, PHILIPPINE ISLANDS[1]

By Paul F. Russell

Of the International Health Division of the Rockefeller Foundation

and

Domingo Santiago

Field Inspector, Malaria Investigations, Manila

ONE PLATE

INTRODUCTION

The common carrier of malaria in the Philippine Islands is *Anopheles minimus.*(1, 2, 3, 4) Its larvæ are found, typically, at the edges of small, clear, flowing streams in shady places where there are clean roots, especially of bamboo, or where there are large stones or undercut banks. They may be found sometimes among drift débris or in small rocky pools recently isolated from a stream. Sometimes they are taken at the margins of large rivers if a steep bank affords acceptable shelter. They may be found in irrigation ditches and occasionally elsewhere.(5, 6, 7, 8, 9)

The purpose of this paper is to report the discovery of *A. minimus* larvæ in wells, a previously unrecognized breeding place of this important species in the Philippine Islands.

TECHNIC

A survey of wells in Masiit and Calauan, Laguna Province, Luzon, was ordered on a chance that anopheline larvæ might be found in them, although there are typical breeding places in abundance for *A. minimus*, *A. barbirostris*, and other species common in these localities. A special dipper was devised (Plate 1), and wells were searched systematically.

RESULTS

In Table 1 are given the results of this survey of wells in Masiit and Calauan. It will be seen that *A. minimus* (typical), *A. barbirostris*, and *A. vagus* var. *limosus* were taken from wells, occasionally in fair numbers. These wells are of the

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[1] This report is from the Calauan laboratory of malaria investigations, a project jointly supported by the Bureau of Science, Manila, and the International Health Division of the Rockefeller Foundation.

TABLE 1.—*Anopheline larvæ in wells in Laguna Province, Luzon.*

Date.	Place.	Well.				Anopheline larvæ.		Adults bred out.	
		Owner.	Depth.		Diameter.	Species.	Number.	Males.	Females.
			Top to surface.	Water.					
1932			*in.*	*in.*	*in.*				
March 2	Masiit	F. G.	74	46	50	*Anopheles minimus*	1	0	0
March 2	do	J. M.	85	59	68		0		
March 2	do	L. N.	64	47	79	*Anopheles minimus*	17	5	6
						Anopheles barbirostris	2	0	0
March 2	do	R. P.	74	48	60	do	1	0	1
March 2	do	C. I.	79	47	48		0	0	0
March 2	do	M. C.	117	59	27	*Anopheles minimus*	4	1	0
March 2	do	F. P.	66	40	36	do	1	0	0
						Anopheles barbirostris	2	1	1
March 2	do	V. B.	67	53	52		0		
March 2	do	B. P.	35	40	35		0		
March 30	Calauan	P. A.	73	57	40		0		
March 30	do	R. B.	63	42	33		0		
March 30	do	I. G.	60	47	53		0		
March 30	do	P. S.	84	45	36		0		
March 30	do	J. M.	46	57	36		0		
March 30	do	S. C.	72	40	34		0		
March 30	do	A. R.	74	55	46		0		
March 30	do	A. M.	88	43	31		0		
March 30	do	R. E.	68	58	66	*Anopheles minimus*	7	0	0
March 30	do	F. M.	43	82	46	do	1	0	0
April 6	do	S. M.	37	38	32		0		
April 6	do	R. M.	76	68	32		0		

April	6	do.	N. K.	75	39	39		0		
April	6	do.	M. V.	51	44	41		0		
April	6	do.	M. M.	55	17	39		0		
April	6	do.	C. P.	41	53	56	*Anopheles minimus*	10	0	0
April	6	do.	I. M.	87	52	38	*Anopheles vagus* var. *limosus*	1	1	0
April	6	do.	G. P.	59	48	52	*Anopheles minimus*	8	0	0
April	6	do.	M. I.	49	56	55		0		
April	6	do.	D. M.	53	22	33	*Anopheles minimus*	1	0	0
April	6	do.	M. H.	37	51	39		0		
April	6	do.	I. P.	30	74	34		0		
April	6	do.	E. A.	31	60	39		0		
April	6	do.	L. K.	34	55	60	*Anopheles barbirostris*	2	0	0

surface type (Plate 1). The water is usually clear, but is not flowing within the wall itself. As a rule, the water is used not for drinking but for bathing and miscellaneous purposes.

Malaria is present in both Calauan and Masiit. For example, Russell(9) recently examined eighty-two school children in Calauan and found a spleen index of 36.6 per cent. *Anopheles minimus* larvæ are abundant in the streams of this region.

How much of a factor these wells may be in the epidemiology of malaria has not been determined. In view of the large numbers of larvæ always to be found in the streams and the relatively few to be found in the wells, it is probable that in this region wells are not an appreciable factor in malaria transmission. In the regions where a pronounced dry season causes a disappearance of the typical stream breeding places of *A. minimus,* it is conceivable that wells might be a factor in continuing the propagation of this species and, perhaps, therefore, also of malaria. This question requires further study.

SUMMARY

Larvæ of the chief malaria carrier, *A. minimus,* and of *A. barbirostris* and *A. vagus* var. *limosus* are here reported, apparently for the first time, as breeding in surface wells in Laguna Province, Philippine Islands.

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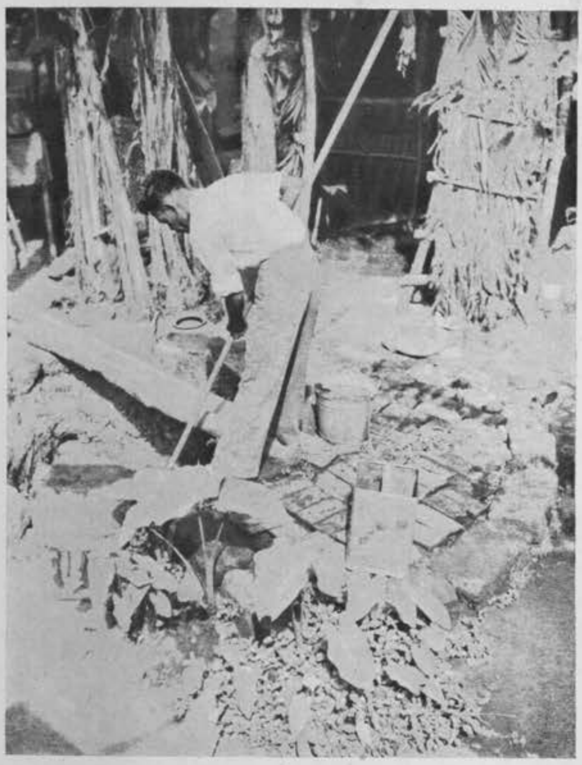
ILLUSTRATION

PLATE 1

FIG. 1. A sanitary inspector with special dipper for catching anopheles larvæ in wells.

2. Special dipper for use in wells, with a joint that permits angulation of the handle.

3. A surface well in Calauan, Laguna Province, Luzon, from which typical larvæ of *Anopheles minimus* were taken.



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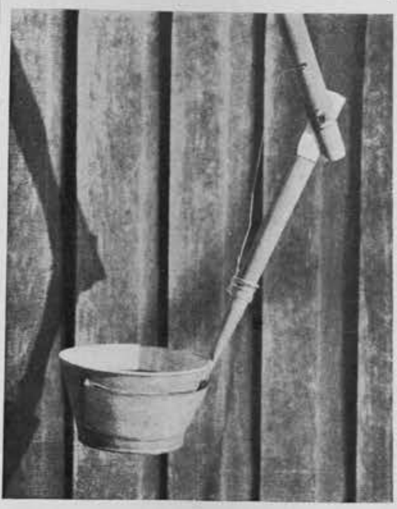

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PLATE 1.

AVIAN MALARIA STUDIES, VI

SUSCEPTIBILITY OF LUTZIA FUSCANA (WIEDEMANN) EDWARDS TO AVIAN MALARIA[1]

By ANDRES M. NONO

Chief Inspector, Malaria Investigations, Manila

ONE PLATE

INTRODUCTION

Huff (1927) summarized the species of mosquitoes susceptible to bird malaria as shown in Table 1.

TABLE 1.—*Species of mosquitoes known to be susceptible to bird malaria.*

Species.	Worker and year.
Culex (*Culex*) *hortensis* Ficalbi, 1889.	Sergents, 1918.
Culex (*Culex*) *quinquefasciatus* Say, 1823.	Ross, 1898.
Culex (*Culex*) *pipiens* Linnæus, 1758.	Ruge, 1901.
Theobaldia longeareolata Macquart, 1838.	Sergents, 1918.
Aëdes (*Ochlerotatus*) *mariae* Ed. Sergents, 1903.	Sergents, 1918.
Aëdes (*Ochlerotatus*) *communis* De Geer, 1776.	Koch, 1899.
Aëdes (*Stegomyia*) *ægypti* Linnæus, 1762.	Sergents, 1907.
Culex territans Walker, 1856.	Huff, 1927.
Culex salinarius Coquillet, 1904.	Huff, 1927.

The last two mentioned species were reported for the first time as susceptible to infection with three species of *Plasmodium* of birds (*cathemerium, praecox,* and *inconstans*). No record of avian malaria infection for *Lutzia fuscana* (Wiedemann) Edwards has been published previous to this account.

For this reason it seems worth while to report positive results on this species. Possibly workers in similar studies may use this species as laboratory material in studying other aspects of malaria.

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[1] From the laboratory of malaria investigations, Paul F. Russell, chief. This project is jointly supported by the International Health Division of the Rockefeller Foundation and the Bureau of Science, Manila. I wish to acknowledge my indebtedness to Doctor Russell in connection with this experiment.

OBJECT

(*a*) To determine the susceptibility of *L. fuscana* for *Plasmodium cathemerium* Hartman, 1924.

(*b*) To determine the susceptibility of the same species of mosquito for *P. capistrani* Russell, 1932.

MATERIALS AND TECHNIC

The birds used in this experiment as host of the parasite were canaries (*Serinus canarius*). The parasites used were *Plasmodium cathemerium* and *P. capistrani.* The mosquito host of the parasite was *Lutzia fuscana.*

Newly emerged adults were used in the experiment. Feeding upon the birds was done at night. The newly emerged adults were first kept three days after emergence in a moist lamp chimney. Sweetened raisins were placed on top of the moistened chimney as food for the mosquitoes. After three days, the insects were transferred from the lamp chimney to a rectangular screened mosquito cage (12 by 12 by 20 inches). Before dusk a heavily infected bird was tied in a small cage (5 by 5 by 5 inches), which was placed within the mosquito cage. The following morning, the engorged females were picked out and placed in a moist lamp chimney for incubation at room temperature.

EXPERIMENT AND RESULTS

SUSCEPTIBILITY OF L. FUSCANA FOR P. CATHEMERIUM

June 29, 1931, two mosquitoes fed upon bird NI, which at that time was heavily infected with parasites. The parasite and red-cell counts on the blood smear, properly stained, are shown in Table 2. Six and one-half days later the mosquitoes were dissected for oöcysts on the stomach. One was negative and the other positive, with a well-defined oöcyst (Plate 1, fig. 1). It measured 33 microns in diameter at this age. The protoplasm was granular with the characteristic pigment in clumps and more or less obscured. One could not mistake an oöcyst at this age because of the definite cyst wall, the characteristic pigment, and its position in the stomach wall. It is of interest to note, however, that we have observed that some oöcysts develop on the inside wall of the stomach. This could be detected by rolling the stomach over until the oöcyst reached the edge of the flattened stomach. If the oöcyst is located on the outside wall it projects, but remains attached to the stomach wall by a narrow constricted neck of muscle tissue which has been distended. On the other hand, if the oöcyst develops on the inside wall of the stomach, we do not notice this bulging out. The cyst simply follows the rolling of the stomach. After some practice we could detect the location of the cyst by focusing the fine adjustment.

TABLE 2.—*Summary of parasite and red-cell counts in birds from which mosquitoes were infected.*[a]

Date.	Bird No.	Parasites per 10,000 red blood cells.	Gametocytes.		Mosquitoes.	
			Per cent.	Per 10,000 red blood cells.	Dissected.	Positive.
June 29, 1931	[b] N-1	8,088	4.3	348	2	1
August 12, 1931	[b] N-35	290	8.6	25	1	1
March 3, 1932	[c] Y-92	181	23.6	25	1	1

[a] Miss Filomena Villacorta, microscopist of the staff of malaria investigations, assisted in counting the red cells and parasites in the blood smears.
[b] Infected with *P. cathemerium*.
[c] Infected with *P. capistrani*.

August 12, 1931, it was decided to check and confirm the first result. One mosquito fed upon bird N-35; blood heavily infected with the same species of *Plasmodium*. The parasite and red-cell counts are shown in Table 2. On dissection of the stomach seven days after the blood meal, nine oöcysts were counted on both sides of the stomach. On further examination with the higher power, the formation of a granular streak could be noted. Unfortunately, no photograph of the oöcyst was taken.

SUSCEPTIBILITY OF L. FUSCANA FOR P. CAPISTRANI

March 3, 1932, one mosquito fed upon bird Y-92; heavily infected with *P. capistrani*. Parasites and red-cell counts on the blood smear are shown in Table 2. On dissection of the stomach, eight and one-half days after the blood meal, eleven oöcysts were counted on both sides of the stomach. Plate 1, fig. 2, shows one oöcyst on the stomach wall. It measured 35 microns at this age. The sporoblastic formation is better observed in fresh specimens.

Two hours later the stomach burst and some of the oöcysts ruptured (Plate 1, fig. 3). Sporozoites in the saline solution along the stomach wall were observed, exhibiting their characteristic movement. They moved sluggishly, forming curves and "s" shapes. The sporozoites were scattered and few could be seen in a field that would insure a good photograph.

SUMMARY AND CONCLUSION

Lutzia fuscana was found to be a vector of *Plasmodium cathemerium* and *P. capistrani.*

Lutzia fuscana has not been reported infected with avian malaria previous to this account.

It is probable that this species may transmit malaria in nature among Philippine birds, if a source of infection is available.

LITERATURE CITED

HUFF, C. G. Studies on infectivity of plasmodia of birds for mosquitoes, with special reference to the problem of immunity in the mosquito. Am. Journ. Hyg. 7 (1927) 706–734.

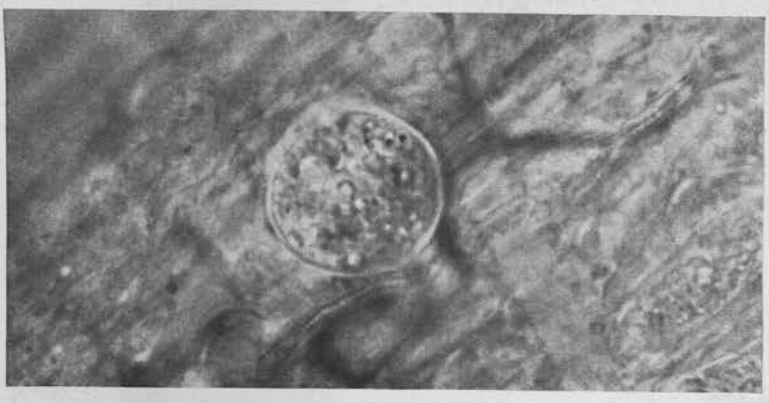
ILLUSTRATION

PLATE 1

FIG. 1. *Plasmodium cathemerium* Hartman, 1924; oöcyst from the stomach wall of *Lutzia fuscana* (Wied.), 33 microns in diameter; protoplasm granular; pigment in clumps and more or less obscured. Six and one-half days old, at room temperature of 31.4° C. and 78.48 average room relative humidity; × 700.

2. *Plasmodium capistrani* Russell, 1932; oöcyst from the stomach wall of *Lutzia fuscana*, 35 microns in diameter; eight and one-half days old, at an average room temperature of 31° C.; × 500.

3. *Plasmodium capistrani;* ruptured oöcyst and an empty capsule from the same stomach in fig. 2. Two sporozoites within the capsule, which have not been released.



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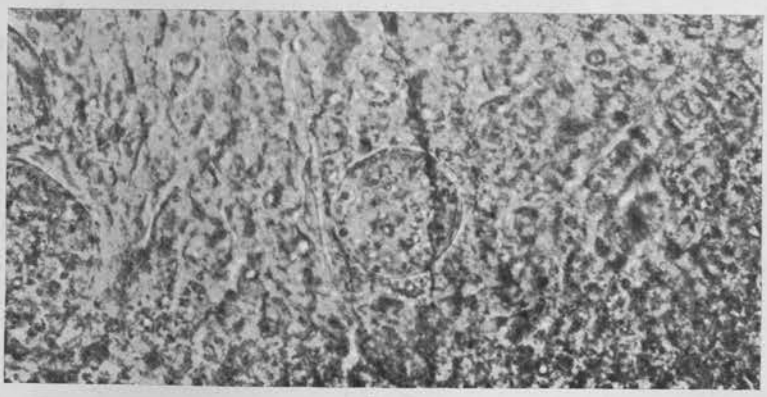

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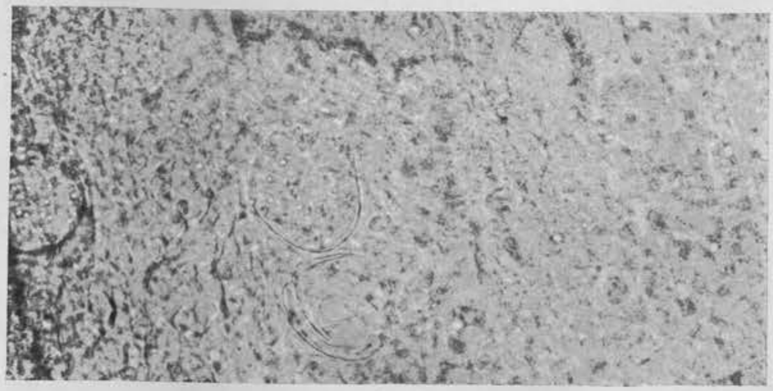

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PLATE 1.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM THE PHILIPPINES (DIPTERA), XVI[1]

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

FOUR PLATES

The present continuation of this series of papers on the tipulid fauna of the Philippines is based on extensive collections made in Tayabas Province, Luzon, by Francisco Rivera, and in Davao district, Mindanao, by Charles F. Clagg. I am very deeply indebted to the collectors of the material, and to Richard C. McGregor, for continued interest in the crane flies of this rich faunal area and for the privilege of retaining in my collection the types of the novelties herein described. Keys to the Philippine species of *Tipula, Epiphragma, Limnophila,* and *Pilaria* are provided.

TIPULINÆ

Genus TIPULA Linnæus

Tipula LINNÆUS, Syst. Nat. ed. 10 (1758) 585.

The known Philippine species of *Tipula* fall within the limits of two well-defined subgenera, *Indotipula* Edwards and *Tipulodina* Enderlein. *Indotipula*[2] is well-represented in the Oriental Region, with fewer species in the adjoining portions of the eastern Palæarctic and Australasian Regions. The subgenus is strongly represented in the Philippines. Previous references made by the present writer to the subgenus *Acutipula* Alexander[3] should be referred to *Indotipula.*

A few characters additional to those given in the original definition by Edwards may be stated. Antennæ 12-segmented, the twelfth segment a mere button; verticils very long; flagellar segments sometimes binodose (*sulaica, angustilobata*). Male hypopygium with the tergite entirely distinct from the sternite-basistyle. Basistyle separated from the sternite by an incomplete suture. Most of the species known to the writer (*manobo* sp. nov. is an exception) have a series of from six to twenty flattened setæ in a single linear row near the outer margin of the inner dististyle. Most of the species have cell M_1 petiolate, as usual in the genus, but a few (*latilobata, manobo, riverai*) have the cell sessile.

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[1] Contribution from the entomological laboratory, Massachusetts State College.

[2] Ann. & Mag. Nat. Hist. X 8 (1931) 81.

[3] Philip. Journ. Sci. 45 (1931) 263.

The Japanese and Chinese species *okinawensis* Alexander, *suensoni* Alexander, and *yamata* Alexander are likewise correctly placed in *Indotipula*. Species in the typical subgenus *Tipula* having similar paired submedian lobes on the ninth tergite differ in having the tergite and sternite-basistyle fused into a continuous ring.

The subgenus *Tipulodina*[4] is well represented in the Philippines by several closely allied species that are most readily separated by details of coloration and structure of the antennæ and male hypopygium. I follow Edwards[5] in placing *Tipulodina* as a subgenus of *Tipula*. The adult flies present few or no decisive characters of generic value, but the nature of the pronotal breathing horns of the pupa in *Tipulodina* indicates that we are here dealing with an isolated group that may require still further consideration as to its strict position when the species are better known. This subgenus is one of the most characteristic in the Oriental Region, with a few additional forms invading the eastern Palæarctic and Ethiopian Regions. The veins of the wing beyond the cord in *Tipulodina* are not entirely devoid of macrotrichia, but veins R_{2+3}, R_{4+5}, and at least the basal portion of R_3 are provided in most species with a nearly complete series of such setæ, the greatest reduction in number being found in species such as *pedata* Wiedemann where only vein R_{4+5} possesses such trichia. In some species, as *mckeani* Cockerell, vein M_1 likewise has macrotrichia throughout its entire length.

The Philippine species of *Tipula* may be separated by means of the accompanying key, which is based in large part on characters of the male sex.

Key to the Philippine species of Tipula Linnæus.

1. Fore tibiæ without spurs; middle tibiæ without, or with but a single spur; legs unvariegated with white; wing tip clear or, if darkened (*fuscoangustata*), the pattern continuous with the stigmal area. (Subgenus *Indotipula* Edwards.) 2.

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[4] Zoöl. Jahrb. 32 pt. 1 (1912) 30–32.

[5] Ann. & Mag. Nat. Hist. X 8 (1931) 76.

Fore tibiæ with one spur; middle tibiæ with two spurs; legs, in almost all regional species, conspicuously variegated with snowy-white rings (lacking in *deprivata*); wing tip darkened, the area separated from the stigmal darkening. (Subgenus *Tipulodina* Enderlein.) .... 8.

2. Cell M_1 deep, sessile or nearly so (*riverai* group) .... 3.

Cell M_1 normal, its petiole subequal to m .... 5.

3. Male hypopygium with the lateral lobes of the ninth tergite narrow, separated from one another by a broad U-shaped notch .... 4.

Male hypopygium with the lateral lobes of the ninth tergite broad, separated from one another only by a narrow linear notch. (Mindanao.) .... *latilobata* sp. nov.

4. Male hypopygium with the median region of the tergal notch produced into a blunt rounded lobe. (Luzon.) .... *riverai* Alexander.

Male hypopygium without lobe at base of tergal notch. (Mindanao.) *manobo* sp. nov.

5. Wings with cells C and Sc dark brown, this coloration continued around margin to wing apex; a conspicuous dark cloud on anterior cord. (Luzon.) .... *fuscoangustata* Alexander.

Wings without darkening in outer end of radial cells or on anterior cord .... 6.

6. Antennæ short, the basal flagellar segments bicolorous, yellow, with the enlargements blackened. (Luzon.) .... *ubensis* sp. nov.

Antennal flagellum uniformly blackened .... 7.

7. Flagellar segments (male) binodose, each segment with a conspicuous distal protuberance, in addition to the basal enlargement. (Mindanao.) .... *angustilobata* sp. nov.

Flagellar segments (male) simple, without distal protuberance. (Luzon.) .... *ifugao* sp. nov.

8. Wings with a dark spot in cell M at near midlength, more extensive in female and then including also cell R .... 9.

Wings without such a darkened area .... 11.

9. Basitarsi black, with a clearly defined white ring at near midlength. (Luzon.) .... *cagayanensis* (Alexander).

Tarsi, including all basitarsi, at most with a nearly obsolete whitish area .... 10.

10. Tibiæ and tarsi entirely blackened. (Mindanao.) *deprivata* sp. nov.

Tibiæ and tarsi with obscure whitish areas that are poorly delimited, most distinct in female. (Luzon.) .... *succinipennis* (Alexander).

11. Legs with basitarsi black, in cases narrowly tipped with white .... 12.

Legs with basitarsi black, each with a white ring at near midlength. 13.

12. Wings hyaline, iridescent; Rs relatively long, subequal to R_{2+3}, leaving an extensive clear area between it and stigma. (Luzon.) *luzonica* (Alexander).

Wings tinged with yellowish; Rs very short, about two-thirds R_{2+3}, practically bordering the inner end of stigma. (Luzon.) *pampangensis* (Alexander).

13. Wings hyaline; mid-basitarsi with white ring; cell 1st M_2 of wings broad, the basal section of vein M_{1+2} more than one-half the second section. (Luzon.) .... *tabuanensis* (Alexander).

Wings with a faint yellowish tinge; mid-basitarsi with the white ring either entirely lacking or barely indicated; cell 1st M_2 of wings narrow, the basal section of M_{1+2} less than one-half the second section. (Luzon.) .... *varitarsis* sp. nov.

The species of *Tipula* in the Philippines, with references to the part of the Philippine series of papers where recorded from the Archipelago, are as follows:

Tipula (*Indotipula*) *angustilobata* sp. nov.; this report.

Tipula (*Indotipula*) *fuscoangustata* Alexander; ALEXANDER, Philippines VI, Philip. Journ. Sci. **41** (1930) 293–294.

Tipula (*Indotipula*) *ifugao* sp. nov.; this report.

Tipula (*Indotipula*) *latilobata* sp. nov.; this report.

Tipula (*Indotipula*) *manobo* sp. nov.; this report.

Tipula (*Indotipula*) *riverai* Alexander; ALEXANDER, Philippines, IV, Philip. Journ. Sci. **33** (1927) 292–293.

Tipula (*Indotipula*) *ubensis* sp. nov.; this report.

Tipula (*Tipulodina*) *cagayanensis* (Alexander); ALEXANDER, Philippines, VII, Philip. Journ. Sci. **43** (1930) 280–281; also, this report.

Tipula (*Tipulodina*) *deprivata* sp. nov.; this report.

Tipula (*Tipulodina*) *luzonica* (Alexander); ALEXANDER, Philippines, II, Philip. Journ. Sci. **27** (1925) 79–81.

Tipula (*Tipulodina*) *pampangensis* (Alexander); ALEXANDER, Philippines, VIII, Philip. Journ. Sci. **45** (1931) 265–266.

Tipula (*Tipulodina*) *succinipennis* (Alexander); ALEXANDER, Philippines, VII, Philip. Journ. Sci. **43** (1930) 279–280.

Tipula (*Tipulodina*) *tabuanensis* (Alexander); ALEXANDER, Philippines, VII, Philip. Journ. Sci. **43** (1930) 277–278.

Tipula (*Tipulodina*) *varitarsis* sp. nov.; this report.

Philippine references to *Tipula* (*Tipulodina*) *cinctipes* de Meijere by Bezzi and to *T.* (*T.*) *pedata* Wiedemann by Osten Sacken, presumably, refer to some one or other of the above-listed species.

TIPULA (INDOTIPULA) LATILOBATA sp. nov. Plate 1, fig. 1; Plate 2, figs. 23, 24.

Belongs to the *riverai* group; mesonotum chiefly yellow, the vague præscutal stripes slightly more orange; flagellar segments with very long verticils; wings grayish subhyaline, cell Sc infuscated, cell C a little less darkened; cell M_1 sessile or nearly so; male hypopygium with the lobes of the ninth tergite very broad, separated from one another only by a linear notch.

Male.—Length, about 14 to 15 millimeters; wing, 15 to 17.5.

Female.—Length, about 20 to 22 millimeters; wing, 18 to 19.

Frontal prolongation of head short, obscure yellow; nasus distinct; palpi obscure yellow. Antennæ 12-segmented; scape and pedicel pale yellow, flagellum black; flagellar segments with long verticils; flagellar segments relatively long and only feebly incised beyond basal enlargement, the apical portion subsinuous (Plate 2, fig. 23); terminal segment very small, about equal in size to the basal enlargement of the other segments. Head above obscure yellow, infuscated medially on vertex.

Mesonotum chiefly yellow, the præscutum with vague indications of more orange stripes. Pleura yellow, immaculate, or with somewhat more orange areas on ventral sternopleurite. Halteres infuscated, the base of stem narrowly paler. Legs with the coxæ and trochanters pale yellow; femora obscure yellow, the tips narrowly blackened; tibiæ brownish yellow, the tips gradually passing into black; tarsi black. Wings (Plate 1, fig. 1) grayish subhyaline, cell Sc infuscated, cell C slightly less darkened; stigma dark brown; very narrow and vague darkenings at wing tip and on anterior cord; veins black. Venation: Cell M_1 very deep, narrowly sessile to very short petiolate.

Abdominal tergites chiefly blackened, including the hypopygium, the basal tergite yellow; basal sternites yellowish. Male hypopygium relatively large, lengthened dorsoventrally, as frequent in the subgenus; tergal region large, extended ventrad, separated from the sternite by an incomplete suture; eighth sternite produced ventrad into a prowlike structure. Median region of tergite (Plate 2, fig. 24, 9*t*) produced into two broad, flattened lobes that are separated from one another only by a linear notch, the apices of the lobes subtruncate to obliquely truncate, densely set with small black spicules. Dististyles (Plate 2, fig. 24, *d*) united at base to an unusual degree, the outer style, *od*, bearing a small glabrous triangular lobule near base; inner style, *id*, of nearly equal size and conformation, short and obtuse, with from seven to nine flattened setæ along outer margin. Notch of ninth sternite with a depressed flattened pale lobe on median line.

MINDANAO, Davao district, Mount Apo (*Clagg*); holotype, male, altitude 6,000 feet, Mainit River, November 15, 1930; allotype, female, altitude 6,500 feet, Mainit River, September 14, 1930; paratypes, altitude 6,000 feet, September 3 and 4, October 12, and November 5, 1930; altitude 6,500 feet, September 5 to 10, 1930; altitude 8,000 feet, September 16, 1930.

The sessile or subsessile cell M_1 of the wings suffices to separate this fly from all allied regional species, excepting *manobo* sp. nov. and *riverai* Alexander, which are readily distinguished by means of the hypopygial characters listed in the key.

TIPULA (INDOTIPULA) MANOBO sp. nov. Plate 2, fig. 25.

Belongs to the *riverai* group; size small (wing, male, 14 millimeters); mesonotum yellow to yellowish orange; legs black; wings grayish subhyaline, cell Sc and the stigma dark brown; male hypopygium with the tergite produced into two lobes that are separated by a broad U-shaped notch; outer dististyle with two weak denticles on inner margin; no flattened setæ arranged in a single definite row on outer margin of inner dististyle.

Male.—Length, about 12 millimeters; wing, 14.

Frontal prolongation of head yellowish brown; nasus conspicuous; palpi pale brown. Antennæ with the scape and pedicel yellow to brownish yellow; flagellum black, the extreme base of the first segment pale; flagellar segments simple, the verticils exceeding the segments. Head yellowish brown to brown, with a faintly indicated median brown vitta.

Mesonotum yellow, the præscutum with scarcely defined orange-yellow stripes. Pleura orange-yellow. Halteres pale, the knobs dark brown. Legs with the coxæ and trochanters yellow; remainder of legs black, the femoral bases restrictedly paler. Wings grayish subhyaline, cell Sc and stigma dark brown; veins brownish black. Venation: Cell M_1 sessile.

Basal abdominal tergites orange-yellow, the outer segments, including the hypopygium, black; in some cases, the lateral margins of the intermediate tergites are conspicuously darkened; basal sternites obscure yellow. Male hypopygium with the caudal margin of tergite (Plate 2, fig. 25, 9*t*) bearing two lobes that are separated by a broad U-shaped notch, the lobes blackened and microscopically spiculose at apex; viewed from above, these lobes appear relatively narrow, viewed laterally they are much higher. Outer dististyle (Plate 2, fig. 25, *od*) flattened, strongly narrowed on distal third, more strongly and abruptly so in the holotype than in the paratype figured; outer margin with coarse spinous setæ, arranged in groups of twos or threes, the inner margin with two obtuse denticulate lobules. Inner dististyle (Plate 2, fig. 25, *id*) relatively short and broad, the posterior and outer margin with numerous coarse setæ but these neither flattened nor arranged in a linear marginal series, as is the case in many other species of the subgenus.

MINDANAO, Davao district, Mount Apo (*Clagg*); holotype, male, altitude 7,000 feet, Seliban River, September 11, 1930; paratopotype, male, with type; paratype, male, altitude 6,000 feet, Galog River, October 22, 1930.

Tipula (*Indotipula*) *manobo* is named from one of the native tribes inhabiting the environs of Mount Apo. The nearest described ally seems to be *T.* (*I.*) *riverai* Alexander (Luzon), which is most readily separated by the genitalic characters given in the key.

TIPULA (INDOTIPULA) UBENSIS sp. nov. Plate 2, fig. 26.

Belongs to the *walkeri* group; general coloration of mesonotal præscutum olive-brown, the lateral margins broadly buffy yellow; antennæ short, bicolorous; wings with a strong brown tinge, cells C and Sc more saturated brown; Rs about one-half longer than R_{2+3}; male hypopygium with the lobes of the tergite broad, obliquely truncated, nearly contiguous on median line.

Male.—Length, about 12 millimeters; wing, 13.

Female.—Length, about 17 millimeters; wing, 14.

Frontal prolongation of head light brown, the lateral portions darker brown; nasus long and conspicuous; palpi pale, the terminal segment black. Antennæ (male) relatively short, if bent backward ending before the wing root; scape and pedicel brownish yellow; basal flagellar segments bicolorous, the enlargement black, the remainder light yellow; color of fifth and succeeding flagellar segments more uniformly darkened; flagellar segments simple. Head dark brown, more grayish on front and on anterior vertex, behind with a capillary darkened median vitta.

Mesonotal præscutum with the disk almost covered by three nearly confluent olive-brown stripes, the posterior interspaces being very narrow and restricted; lateral margins of sclerite abruptly and broadly buffy yellow; scutum pale, the lobes largely covered by pale brown areas; scutellum and postnotum pale brown, the latter variegated on sides by yellow. Pleura buffy yellow, variegated with brown on anterior anepisternum, ventral sternopleurite, and ventral meron. Halteres yellow, the knobs infuscated. Legs with the coxæ pale buffy, the fore and middle coxæ more infuscated; trochanters yellow; femora yellow, the tips narrowly dark brown; tibiæ and tarsi yellow, the terminal tarsal segments darkened. Wings with a strong brown tinge, the base and cubital region more yellowish, cells C and Sc, with the stigma, more saturated brown; veins light brown. Macrotrichia on veins R_3, R_{4+5}, and M_1. Venation: Rs relatively long, about one-half to two-thirds longer than R_{2+3}; petiole of cell M_1 subequal to or longer than m.

Abdominal tergites obscure yellow, margined laterally and caudally with brown, the outer segments more uniformly darkened; sternites more uniformly yellow. Male hypopygium with the tergite (Plate 2, fig. 26, *9t*) very extensive, the lobes broad, obliquely truncated, set with sparse blackened spicules and coarse setæ; lobes separated on midline only by a linear notch. Outer dististyle (Plate 2, fig. 26, *od*) broad, narrowed at apex into a slender portion; caudal margin of style before point of narrowing with numerous setæ that are longer than elsewhere on surface. Inner dististyle (Plate 2, fig. 26, *id*) broad, the flattened setæ along outer margin about twelve in number.

LUZON, Laguna Province, Ube (*Rivera*); holotype, male; paratypes, 2 males; Tayabas Province, Lucban, altitude, 1,400 feet, January 24, 1931 (*Rivera*); allotype, female.

Tipula (*Indotipula*) *ubensis* is very different from the remaining Philippine species of the subgenus, the short, bicolorous antennæ and structure of the male hypopygium, readily sufficing to define the species. It is more similar and allied to the Japanese and Chinese members of the subgenus that center about *T.* (*I.*) *yamata* Alexander.

TIPULA (INDOTIPULA) IFUGAO sp. nov. Plate 2, fig. 27.

Belongs to the *walkeri* group; antennal flagellum black throughout; petiole of cell M_1 exceeding one-half m; male hypopygium with two obtuse blackened lobes that are separated from one another by a V-shaped notch; inner dististyle complex in structure.

Male—Length, about 13 millimeters; wings, 14.5.

Frontal prolongation of head light ocherous; nasus very long; palpi pale, the terminal segment darker. Antennæ with the scape and pedicel yellow, flagellum black; flagellar segments unusually long, simple, the verticils exceeding the segments. Head gray, the front and occiput more yellowish; a capillary blackish median line.

Mesonotum brownish ocherous, the præscutal stripes only poorly defined. Pleura light yellow, scarcely variegated with darker. Halteres pale, the knobs infuscated. Legs with the coxæ and trochanters pale yellow; femora yellowish brown to light brown, their tips darkened; remainder of legs passing into black. Wings subhyaline, cell C faintly darkened, cell Sc and stigma dark brown; veins brownish black. Venation: Rs subequal to R_{2+3}; petiole of cell M_1 exceeding one-half m.

Basal abdominal tergites yellow, the outer segments more infuscated, their extreme caudal margins pale; sternites more yellowish. Male hypopygium with the tergite produced into two cylindrical blackened lobes that are separated only by a narrow V-shaped notch, their tips obtuse. Outer dististyle (Plate 2, fig. 27, *od*) gradually narrowed outwardly, with numerous, chiefly marginal setæ. Inner dististyle, *id*, a complex structure, as shown (Plate 2, fig. 27), the outer portion bearing a slender blackened spine.

LUZON, Mountain Province, Ifugao Subprovince, Hungduan, April 5, 1930 (*Rivera*); holotype, male.

The specific name, *ifugao*, is that of a tribe of mountain people of northern Luzon. The species is quite distinct from the other regional species of *Indotipula* in the structure of the ninth tergite and inner dististyle of the male hypopygium.

TIPULA (INDOTIPULA) ANGUSTILOBATA sp. nov. Plate 1, fig. 2; Plate 2, figs. 28, 29.

Belongs to the *sulaica* group; size large (wing, male, over 17 millimeters); antennal flagellum black, the segments conspicuously binodose, the basal enlargement with very long verticils; wings with a strong brownish yellow tinge; cell M_1 with its petiole subequal to m; male hypopygium with the two lobes of the tergite blackened, narrowed outwardly into slender spiculose points, the surface of the lobes with abundant coarse setæ.

Male.—Length, about 16 to 17 millimeters; wing, 18 to 20.

Frontal prolongation of head yellow above, darkened laterally; nasus long and conspicuous; basal three segments of palpi obscure yellow, the terminal segment a trifle darker. Antennæ (Plate 2, fig. 28) with the scape, pedicel, and base of first flagellar segment yellow; remainder of organ black, 12-segmented; flagellar segments beyond the first conspicuously binodose, as in *sulaica;* verticils very long and conspicuous. Head brownish gray, the median area and spots caudad of the antennal fossæ more blackened.

Mesonotal præscutum buffy, almost covered by four, dark fulvous-brown stripes, these in cases narrowly bordered by still darker brown; scutal lobes obscure yellow, each with two dark fulvous-brown areas; scutellum yellowish testaceous, with a faint brown median vitta; postnotum yellowish brown. Pleura yellow, vaguely variegated on anepisternum, ventral sternopleurite and meron with more reddish brown. Halteres brown, the base of stem restrictedly paler. Legs with the coxæ and trochanters yellow; femora brownish yellow, the tips narrowly dark brown; tibiæ brown, the tips narrowly blackened; tarsi black. Wings (Plate 1, fig. 2) with a strong brownish yellow tinge, cell Sc more brownish, cell C more yellowish; stigma yellowish brown; veins dark brown. Venation: Cell M_1 with the petiole variable in length, from about three-fourths to longer than m.

Abdominal tergites dark brown, the outer segments passing into black, the basal tergite more reddish brown; caudal and lateral margins of segments narrowly pale; basal sternites reddish brown, the outer segments more blackened. Male hypopygium with the tergite (Plate 2, fig. 29, 9*t*) bearing two triangular blackened lobes on either side of midline, these narrowed into slender points that are tipped with weak blunt spinules; surface of lobes with numerous coarse setæ. Outer dististyle (Plate 2, fig. 29, *od*) elongate, gradually widened outwardly, the posterior margin with numerous setæ. Inner dististyle (Plate 2, fig. 29, *id*) with about twenty flattened setæ in a row along outer margin.

MINDANAO, Davao district, Mount Apo (*Clagg*); holotype, male, altitude 7,000 feet, Baroring River, November 9, 1930; paratopotypes, 2 males, November 8 and 9, 1930; paratypes, 1 male, altitude 6,500 feet, Seliban River, September 11, 1930; 1 male, Taloon trail, Santa Cruz Mountain, altitude 3,000 to 5,000 feet, September 13, 1930; 1 male, La Lun Mountains, altitude 5,500 feet, January 2, 1931.

Tipula (*Indotipula*) *angustilobata* is most nearly allied to *T.* (*I.*) *sulaica* (Walker) Edwards, which is known to me only by the brief note and figure by Edwards.[6] If this species was actually described by Walker, it has been overlooked by all recent cataloguers of the Oriental Diptera (Kertész, Brunetti, Pierre); if not described, the name should be credited to Edwards on the basis of the above reference. The Walker type was from Sula Island, east of Celebes, while the material considered by Edwards as being conspecific was from Borneo. Edwards compares *sulaica* with *T.* (*I.*) *gedehicola* Alexander (Java), indicating the approximate similarity of the male hypopygium. The fly above described has a very different hypopygium, shown most evidently in the narrowly pointed lobes of the ninth tergite and the distinct conformation of both dististyles. The fly is one of the largest species of the subgenus so far made known. The peculiar binodose flagellar segments are much as in *sulaica* and may well occur in other still undiscovered species in the Malayan Islands.

[6] Sarawak Mus. Journ. 3 (1926) 277, pl. 10, fig. 46.

TIPULA (TIPULODINA) CAGAYANENSIS (Alexander).

Tipulodina cagayanensis ALEXANDER, Philip. Journ. Sci. 43 (1930) 280–282.

The types were from Mount Tabuan, Cagayan Province, Luzon. A male and a female were taken by Rivera at Lucban, Tayabas Province, Luzon, January 23 to 26, 1931. The antennæ of the male sex are notably shorter than in *luzonica* (Alexander). The darkened area in the basal cells of wing is restricted to cell M in the male, while being much larger and including both cells R and M in the female.

TIPULA (TIPULODINA) VARITARSIS sp. nov. Plate 1, fig. 3; Plate 2, fig. 30.

Male.—Length, about 13 to 14 millimeters; wing, 14.5 to 17.

Most similar to *T.* (*T.*) *tabuanensis* (Alexander), differing in the details of coloration and venation. Palpi dark, the second segment, base of third and distal half of fourth pale. Antennæ (male) elongate, if bent backward extending about to base of second abdominal segment; flagellar segments black, the extreme incisures pale. Middle legs with the basitarsi entirely blackened or with only vague suggestions of a pale annulus. Wings (Plate 1, fig. 3) with a pale yellow tinge; dark pattern much as in *tabuanensis* but the seams along cord and veins of outer medial field more extensive and continuous. Venation: Rs longer and cell 1st M_2 narrower than in *tabuanensis*, the first section of vein M_{1+2} being about two-fifths the second section; in *tabuanensis* this element is about three-fifths the second. Abdomen with the blackened subterminal rings even, not produced cephalad medially, as is the case in some of the other species of the subgenus. Male hypopygium (Plate 2, fig. 30) with the outer dististyle, *od*, blackened only at extreme apex, the remainder densely setiferous, especially a dense fringe along outer margin.

LUZON, Tayabas Province, Lucban (*Rivera*); holotype, male, January 26, 1931; paratypes, 3 males, January 25 and 26, 1931.

TIPULA (TIPULODINA) DEPRIVATA sp. nov. Plate 1, fig. 4.

Female.—Length, about 25 millimeters; wing, 20.

Closely allied to *T.* (*T.*) *succinipennis*, differing as follows: Palpi with terminal segment entirely pale. Mesonotal præscutum with the ground color yellow, the four usual stripes olive-brown, but little distinct against the ground, their margins a little darker; postnotal mediotergite almost covered by a dark brown central portion. Legs (only a middle leg remains) with the femora yellow, the tips conspicuously blackened, without subterminal brightening; tibiæ and tarsi dark brown to brownish black, with no indication of paler annuli. Wings (Plate 1, fig. 4) with the ground color much paler yellow than in *succinipennis* but still not of the iridescent hyaline clearness of other Philippine species; dark area in cells R and M including both cells; cell Sc, cord, outer end of cell 1st M_2, veins of outer medial field and wing tip in radial field brown; stigma relatively large, its cephalic-proximal portion lying above vein $Sc_2 + R_1$ pale yellow. Trichiation of veins as in *succinipennis*, being found on R_{4+5} and basal half of R_3. Venation: Rs subequal to R_{2+3}; cell R_3 at margin more extensive than cell R_2; outer medial and cubital cells deep. Abdominal tergites chiefly dark brown, the basal rings buffy; lateral margins grayish brown; an interrupted brownish black dorsomedian vitta.

MINDANAO, Davao district, Mount Apo, Sibulan River, altitude 5,000 to 6,000 feet, October 20, 1930 (*Clagg*); holotype, female.

The present fly is most nearly allied to *T.* (*T.*) *succinipennis* (Alexander) among the described Philippine species, differing in the pattern of the mesonotum and in the entirely unbanded legs. The yellow tinting of the wings is intermediate in degree between that of the amber-colored wings of *succinipennis* and the usual crystal-clear wings of the commoner Philippine species. The fly is likewise allied to *T.* (*T.*) *albiprivata* Edwards (Borneo), which differs in the distinct coloration of the thorax, together with the nearly hyaline ground color of the wings, with a slightly different pattern.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) CAPELLA sp. nov. Plate 1, fig. 5; Plate 2, fig. 31.

Belongs to the *albitarsis* group; general coloration of mesonotum dark brown; tarsi extensively snowy white; wings with a strong brown suffusion, the cord and outer end of cell 1st M_2 narrowly seamed with darker; male hypopygium with the dorsal dististyle a slender blackened rod; rostral spine long and slender, arising from a long basal tubercle that is fully one-third as long as the spine itself.

Male.—Length, about 5 millimeters; wing, 6.2.

Rostrum and palpi black. Antennæ black throughout; flagellar segments with short apical necks; longest verticils about one-half longer than the segments; terminal segment elongate. Head dark brown.

Mesonotum uniformly dark brown. Pleura with the dorsal sclerites brownish black, the ventral sternopleurite dark brown, the dorsal sternopleurite a little brightened. Halteres black, the extreme base of stem obscure yellow. Legs with the coxæ brown, the fore coxæ somewhat darker; trochanters brownish yellow; femora and tibiæ black; tarsi white, on middle legs the basitarsi with a little more than the proximal four-fifths blackened; fore and hind legs broken; claws elongate, with a long basal spine on lower face and a much smaller appressed spinule at near midlength. Wings (Plate 1, fig. 5) with a strong brown suffusion, the costal region somewhat more saturated; a narrow stigmal seam and poorly indicated clouds along cord and outer end of cell 1st M_2 darker brown; veins dark brown. Venation: Sc_1 ending about opposite three-fourths the length of Rs, Sc_2 some distance from its tip; free tip of Sc_2 and R_2 in approximate transverse alignment; m-cu just beyond the fork of M; vein 2d A converging strongly toward 1st A.

Abdomen black, the caudal margins of the individual segments paler; eighth segment pale; hypopygium dark. Male hypopygium (Plate 2, fig. 31) with the ninth tergite, *9t*, transverse, the caudal margin gently emarginate. Basistyle, *b*, elongate, the ventromesal lobe basal in position, bearing a slender clavate extension. Dorsal dististyle a slender, nearly straight, blackened rod. Ventral dististyle, *vd*, oval, the rostral spine very long and slender, from an enlarged basal tubercle that is fully one-third as long as the spine itself. Gonapophyses, *g*, with the mesal-apical lobe stout. Ædeagus, *a*, with the apex simple.

MINDANAO, Davao district, Mount Apo, Galog River, altitude 6,000 feet, October 21, 1930 (*Clagg*); holotype, male.

Limonia (Limonia) capella is quite distinct from the allied *L. (L.) subalbitarsis* Alexander (Luzon) in the small size and distinct male hypopygium, especially the long basal tubercle of the rostral spine, the slender dorsal dististyle, and the simple apex of the ædeagus.

LIMONIA (LIMONIA) BRACHYNEURA sp. nov. Plate 1, fig. 6; Plate 2, fig. 32.

Closely allied to *calianensis;* general coloration orange, the mesonotum with two narrow, dark brown, nearly parallel stripes extending from midlength of the præscutum to the base of abdomen; pleura with a broad dark brown longitudinal stripe; wings strongly tinged with blackish; Sc relatively short, ending about opposite one-third the length of Rs; male hypopygium with the two rostral spines placed close together on the actual face of style, their bases completely encircled by microscopic setulæ.

Male.—Length, about 3.6 millimeters; wing, 4.

Mouth parts greatly reduced in size, black. Antennæ black throughout; flagellar segments oval, the outer segments becoming more slender and elongate; terminal segment elongate, subequal to the penultimate; verticils very long and conspicuous, especially on the outer segments, chiefly unilaterally arranged. Head orange; anterior vertex very broad.

Pronotum yellow, blackened on sides. Mesonotum with the præscutum chiefly covered by three orange-yellow stripes that are confluent in front, the dark brown interspaces represented by conspicuous lateral margins and posterior intermediate lines, the latter continued caudal, crossing the scutal lobes, scutellum, and postnotal mediotergite, nearly parallel or but gently converging at the abdomen. Pleura light yellow, traversed by a broad, dark brown, longitudinal stripe. Halteres brownish black, the base of stem narrowly brightened. Legs with the coxæ and trochanters pale yellow; remainder of legs black, the femoral bases restrictedly brightened; claws slender, with a long erect basal spine and a more-appressed lateral spine at midlength. Wings (Plate 1, fig. 6) strongly tinged with blackish; very vague, slightly darker seams along cord and outer end of cell 1st M_2; stigma appearing as a narrow seam on R_2; veins slightly darker. Venation: Sc short, Sc_1 ending about opposite one-third to one-fourth the length of Rs, Sc_2 at its tip; m-cu more than one-half its length beyond the fork of M.

Abdominal tergites dark brown; basal sternites yellow, the outer segments dark brown with their caudal margins narrowly yellow. Male hypopygium (Plate 2, fig. 32) with the tergite, *9t,* transverse, its caudal margin weakly emarginate. Dorsal dististyle glabrous. Rostral prolongation of ventral dististyle, *vd,* elongate, slightly bent at beyond midlength; rostral spines placed on face of style and not at the base of the prolongation, as in *calianensis,* their fossæ being entirely surrounded by microscopic setulæ. Gonapophyses, *g,* elongate, pale, as in *calianensis.*

LUZON, Tayabas Province, Lucban, January 24, 1931 (*Rivera*); holotype, male.

Limonia (*Limonia*) *brachyneura* is allied to *L.* (*L.*) *calianensis* Alexander (Luzon, Mindanao), differing especially in the short subcosta and the slightly different male hypopygium, notably the basal position of the insertion of the rostral spines.

LIMONIA (LIMONIA) BROWNI sp. nov. Plate 1, fig. 7; Plate 3, fig. 33.

Allied to *Limonia ligayai;* general coloration of mesonotal præscutum brownish black, obscure yellow sublaterally; antennal segments (male) not pedicellate apically; tibiæ and tarsi conspicuously paler than the femora; wings dusky, the stigma darker brown; male hypopygium with the gonapophyses very broad, the mesal-apical angle an acute spine.

Male.—Length, about 4 millimeters; wing, 4.5.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval to subcylindrical, without glabrous apical necks; verticils subequal in length to the segments; terminal segment a little exceeding the penultimate, at apex narrowed to a button. Head blackish, the narrow anterior vertex slightly pruinose.

Mesonotal præscutum with the ground color obscure yellow, the dorsum almost covered by three confluent brownish black stripes; lateral margins of præscutum behind the pseudosutural foveæ narrowly infuscated; posterior sclerites of mesonotum blackened. Pleura obscure yellow, traversed by a narrow, black, longitudinal stripe that passes beneath the root of the halteres, the latter black with the base of the stem narrowly but conspicuously yellow. Legs with the coxæ and trochanters obscure yellow; femora black; tibiæ yellowish brown, the bases of fore and middle tibiæ more infuscated, the tips of all tibiæ very narrowly and insensibly darkened; tarsi obscure yellow, the outer segments darkened; claws small, with about three slender spines at base, the outermost largest, the more basal ones setiform. Wings (Plate 1, fig. 7) with a dusky tinge, the costal region darker; stigma short-oval, brown; veins dark brown. Venation: Sc_1 ending about opposite midlength of Rs, Sc_2 not far from its tip; m-cu just beyond fork of M.

Abdominal tergites black, the basal sternites more yellowish brown; hypopygium dark. Male hypopygium (Plate 3, fig. 33) with the tergite, *9t,* transverse, narrowed outwardly, the caudal portion weakly emarginate. Dorsal dististyle, *dd,* a long, curved, acutely pointed rod, its surface with long delicate setulæ. Rostral prolongation of ventral dististyle, *vd,* elongate, the two spines at its base. Gonapophyses, *g,* very broad, the mesal-apical angle a short, acute, curved spine, the margin of the apophysis adjoining this spine provided with microscopic serrulations. Ædeagus, *a,* deeply notched at apex.

LUZON, Tayabas Province, Lucban, January 26, 1931 (*Rivera*); holotype, male; paratype, male.

Limonia (*Limonia*) *browni* is named in honor of Director William H. Brown, of the Philippine Bureau of Science, to whom I express my indebtedness for coöperation in making known the extensive tipulid fauna of the Islands. The fly is most nearly allied to *L.* (*L.*) *ligayai* Alexander (Luzon, Mindanao) in the setiferous outer dististyle and structure of the inner dististyle of the male hypopygium, differing conspicuously in the nonpedicellate flagellar segments and in the very differently constructed gonapophyses and narrow tergite of the hypopygium.

LIMONIA (DICRANOMYIA) SUBORTHIA sp. nov. Plate 1, fig. 8; Plate 3, fig. 34.

General coloration of thorax gray, the præscutum with a median dark brown stripe; knobs of halteres orange; femora yellow, with a narrow, dark brown, subterminal ring; wings with costal fringe (male) long and conspicuous; disk cream-colored with a heavy brown pattern that is chiefly costal but includes large darkened areas at ends of both anal veins; abdominal segments dark brown, their caudal margins broadly yellow.

Male.—Length, 4.2 to 4.5 millimeters; wing, 5 to 5.5.

Female.—Length, about 5 millimeters; wing, 5.5.

Rostrum and palpi black. Antennæ black; scape more or less pruinose; flagellar segments oval; verticils short, subequal to the segment. Head brownish gray.

Mesonotal præscutum gray with a median dark brown stripe; scutal lobes similarly darkened; posterior sclerites of mesonotum dark gray. Pleura dark gray, more or less variegated by blackish areas. Halteres testaceous, the knobs orange. Legs with the fore coxæ blackened, the remaining coxæ somewhat paler; trochanters yellow; femora yellow, with a narrow dark brown subterminal ring; tibiæ brownish yellow, the tips narrowly darkened; tarsi brownish-yellow, the outer segments darker. Wings (Plate 1, fig. 8) cream-colored, heavily patterned with brown, including a series of about five areas in the costal region, the fourth, largest, being the stigma; smaller marginal clouds at ends of medial and cubital veins, with large conspicuous areas at ends of both anal veins; cord and outer end of cell 1st M_2 narrowly seamed with brown; veins pale, darker in the infuscated areas. Costal fringe (male) long and conspicuous. Venation Sc_1 ending opposite or shortly beyond the origin of Rs, Sc_2 far from its tip, being placed in the second dark costal area; m-cu close to fork of M, subequal to or longer than the distal section of Cu_1; cell 2d A wide.

Abdomen dark brown, the caudal margins of the segments conspicuously ringed with obscure yellow; hypopygium reddish brown, especially the ventral dististyle. Male hypopygium (Plate 3, fig. 34) with the basistyle, *b*, small, with its ventral-mesal lobe large. Ventral dististyle, *vd*, large and fleshy, the rostral prolongation small, with two short spines that are placed close together. Dorsal dististyle a very strongly curved hook, the extreme tip gently upcurved.

MINDANAO, Davao district, Mati, Mount Mayo, altitude 5,000 feet (*Clagg*); holotype, male, January 28, 1931; allotype, female, January 30, 1931; paratopotypes, 8 males and females, January 28 to 30, 1931; paratype, 1 male, Calian, La Lun Mountains, altitude 5,500 feet, December 29, 1931 (*Clagg*).

Although closely allied to *Limonia* (*Dicranomyia*) *orthia* Alexander (Luzon), the present species is clearly distinct in the entirely different pattern of the legs and in the long, erect costal fringe in the male sex. The paratype male from the La Lun Mountains has the costal fringe short but with the leg pattern as in *suborthia* and is here considered as belonging to the present species, although the possibility exists that there is still another closely allied species or race involved.

LIMONIA (DICRANOMYIA) ORTHIOIDES sp. nov. Plate 1, fig. 9.

Allied to *orthia;* mesonotum brown, sparsely pollinose, the præscutum without distinct markings; knobs of halteres infuscated; legs dark brown; wings pale grayish, with a restricted dark costal pattern; cell 1st M_2 tending to be open by the atrophy of m.

Male.—Length, about 4.5 millimeters; wing, 5.3.

Female.—Length, about 4.8 millimeters; wing, 5.2.

Rostrum, palpi, and antennæ black; basal flagellar segment longer than the second; intermediate segments short-oval, the outer segments more elongate; terminal segment a little exceeding the penultimate; longest verticils of basal and intermediate flagellar segments about one-half longer than the segments alone. Head light gray, more infuscated medially behind.

Mesonotum brown, with a sparse yellow pollen, the præscutum without distinct stripes; scutal lobes conspicuously darkened; posterior sclerites of mesonotum dark brown, sparsely pruinose. Pleura pale, the anepisternum and ventral sternopleurite variegated with darker. Halteres pale, the knobs infuscated. Legs with the fore coxæ dark brown, the remaining coxæ paler; trochanters obscure yellow; remainder of legs dark brown, the femoral bases restrictedly pale. Wings (Plate 1, fig. 9) with a grayish tinge, the prearcular region somewhat paler; a restricted dark costal pattern, including small darkened areas above arculus, at Sc_2, and at tip of Sc_1; stigmal area larger; no distinct cloudings elsewhere on membrane. Venation: Sc_1 ending opposite origin of Rs, Sc_2 far before its tip, at near mid-distance between arculus and tip of Sc_1; cell 1st M_2 tending to be open by the atrophy of m; m-cu close to fork of M; cell 2d A wide.

Abdomen dark brown, the eighth segment paler; caudal margins of the individual segments slightly paler. Male hypopygium much as in *orthia* and *suborthia*.

MINDANAO, Davao district, Mount Apo, Sibulan River, altitude 7,000 to 8,000 feet, September 21, 1930 (*Clagg*); holotype, male; allotype, female.

Limonia (*Dicranomyia*) *orthioides* is readily told from both *L.* (*D.*) *orthia* Alexander (Luzon) and *L.* (*D.*) *suborthia* sp. nov. (Mindanao) in the slightly patterned wings, with cell 1st M_2 tending to be open by the atrophy of m. It is further told from *suborthia* by the infuscated knobs of the halteres, the dark brown legs, and the short costal fringe of the male sex. Cell 1st M_2 is entirely open on both wings of the allotype and partly open on one wing of the holotype.

LIMONIA (RHIPIDIA) SERVILIS sp. nov. Plate 1, fig. 10; Plate 3, fig. 35.

Belongs to the *maculata* group; antennæ (male) with six bipectinate flagellar segments; median præscutal stripe entire or nearly so; knobs of halteres dark brown; wings creamy white, with an abundant brown and gray spotted and clouded pattern, the gray areas abundant and confluent; Sc_1 ending about opposite midlength of Rs; m-cu shortly before the fork of M; male hypopygium with four rostral spines.

Male.—Length, about 5 millimeters; wing, 5.7.

Female.—Length, about 5.5 millimeters; wing, 5.6.

Rostrum and palpi brownish black. Antennæ (male) with the scape, pedicel, and flagellar branches brownish black, the long apical pedicels of all branched segments whitish; flagellar segments 2 to 7 each with two branches, the longest about one-half longer than the segment itself; eighth flagellar segment with a single branch that is subequal to the segment itself; remaining flagellar segments simple. Antennæ (female) with the basal flagellar segments produced on ventral face. Head blackish gray; anterior vertex narrow.

Mesonotal præscutum covered with a yellowish pollen, leaving a broad, entire, dark brown or black, median area and narrower, less distinct, lateral stripes; scutal lobes darkened; scutellum and postnotum dark brown, sparsely pruinose. Pleura brownish gray, narrowly striped longitudinally with darker. Halteres pale, the knobs dark brown. Legs with the coxæ dark; trochanters obscure yellow; remainder of legs dark brown, the femoral bases slightly paler; in male, the femora more yellowish brown, the tips darkened. Wings (Plate 1, fig. 10) with the ground color creamy white, the costal region more yellowish; a heavy brown and gray spotted and clouded pattern, the darker areas being costal in position, five or six in number, the fifth being at stigma, the third and fourth areas, at origin of Rs and tip of Sc, separate; all gray areas more or less confluent and chiefly obscuring the ground color; veins brown, paler in the costal interspaces. Costal fringe relatively long, especially in male. Venation: Sc_1 ending at near midlength of Rs, Sc_2 at its tip; m-cu shortly before fork of M.

Abdomen dark brown; hypopygium paler. Male hypopygium (Plate 3, fig. 35) with the rostral prolongation of the ventral dististyle, *vd,* relatively long, with four spines that are directed basad at their tips, arising from a close group at near two-thirds the length of the prolongation.

MINDANAO, Davao district, La Lun Mountains, altitude 5,500 feet, December 31, 1930 (*Clagg*); holotype, male; allotype, female.

Limonia (*Rhipidia*) *servilis* is closely allied to several other regional species of the *maculata* group in the Malayan fauna, especially *L.* (*R.*) *griseipennis* (Edwards) of Borneo, *L.* (*R.*) *javanensis* (de Meijere) of Java, and *L.* (*R.*) *triarmata* Alexander of Formosa. From the last two it differs in the presence of only six branched flagellar segments in the male and in the armature of the male hypopygium, especially the number of rostral spines. The male sex of *griseipennis* has not been fully described. The present fly differs from it most evidently in the entire median præscutal stripe and the uniformly darkened knobs of the halteres.

LIMONIA (EUGLOCHINA) CAPTIOSA sp. nov. Plate 1, fig. 11.

Size large (wing, male, 8.5 millimeters or more); proximal ends of basitarsi extensively blackened, including approximately two-thirds the total length of the segment; wings with Rs not contiguous to the proximal end of stigma; male hypopygium with the ventral dististyle very large, oval.

Male.—Length, about 8 to 9 millimeters; wing, 8.5 to 11.

Female.—Length, about 8 to 9 millimeters; wing, 8 to 9.

Rostrum, palpi, and antennæ black; flagellar segments elongate-oval, with short glabrous apical necks and long, secund verticils that are approximately twice as long as the segments. Head brownish black.

Pronotum and mesonotal præscutum brownish black medially, obscure yellow laterally; scutal lobes extensively brownish black; posterior sclerites of mesonotum more yellowish. Pleura brownish yellow. Halteres elongate, pale brown, the knobs darker. Legs with the coxæ, trochanters, and bases of femora pale yellow, the remainder of femora, all tibiæ, and proximal ends of basitarsi black; remainder of tarsi snowy white; the amount of blackening on basitarsi slightly variable, including about the proximal two-thirds of the segment. Wings (Plate 1, fig. 11) with a brownish tinge, the oval stigma darker brown; veins brownish black. Venation: Sc relatively long, the space on Sc between the tip of Sc_1 and origin of Rs less than twice the length of the stigma; Rs angularly bent at near midlength, not lying contiguous to the proximal end of stigma, as in *arachnobia, cuneiformis,* and other species; basal section of R_{4+5} angularly bent before midlength; vein 2d A long, ending opposite or just before the level of tip of Sc_1.

Abdominal tergites brownish black; basal sternites more yellowish; hypopygium dark. Male hypopygium with the ventral dististyle unusually large, oval in shape.

MINDANAO, Davao district, Mount Apo (*Clagg*); holotype, male; allotype, female, Mainit River, altitude 6,500 feet, September 10, 1930; paratopotypes, 2 males; paratypes, 1 female, Mainit River, altitude 6,000 feet, September 4, 1930; 1 male, 2 females, Kidopawan train from Lake Lino, altitude 7,000 to 8,000 feet, September 20 and 21, 1930; 1 male, 1 female, Baroring River, altitude 7,000 feet, November 8, 1930; 1 male, Bawook Falls, Sibulan River, altitude 2,000 feet, November 13, 1930; 1 male, 2 females, La Lun Mountains, altitude 5,000 feet, January 1, 1931.

In its large size and venation, *Limonia* (*Euglochina*) *captiosa* is similar to *L.* (*E.*) *dignitosa* Alexander (western China), differing in the extensive blackened proximal ends of the basitarsi. The fly differs from *L.* (*E.*) *arachnobia* Alexander (Philippines) in the large size, details of venation, as the relation of Rs to the proximal end of stigma, and the large oval ventral dististyle of the male hypopygium. There appear to be several species of *Euglochina* in the Malayan Region that are very difficult of separation, the male hypopygium being generally similar in all species, leaving the chief characters for separation in the size, the venation, especially the relative length of Sc and the length and position of Rs, and the presence and degree of blackening of the basitarsi of all legs.

LIMONIA (PSEUDOGLOCHINA) BILATIOR sp. nov. Plate 1, fig. 12.

General coloration of mesonotal præscutum chestnut-brown; thoracic pleura yellow dorsally, brown on ventral sclerites; tibiæ and tarsi snowy white, the former with a narrow subbasal and a broad postmedial brownish black ring, the latter subequal to or a trifle longer than the whitened apex beyond; wings with a faint brown tinge, the oval stigma dark brown; vein 2d A with the arched portion short; abdominal segments dark brown, ringed caudally with yellow.

Female.—Length, about 6.5 millimeters; wing, 7.4.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval, with conspicuous glabrous apical necks that are from one-third to one-fourth the length of the enlargement; ventral verticils elongate, the longest fully twice the segment; terminal segment elongate. Head brown; anterior vertex broad.

Pronotum obscure brownish yellow. Mesonotal præscutum uniformly chestnut-brown, the posterior sclerites of mesonotum darker brown. Pleura chiefly obscure yellow on dorsal portion, the ventral pleurites, including the extensive sternopleurite, dark brown. Halteres dark brown. Legs with the coxæ and trochanters dark brown, the posterior coxæ a little paler basally; femora brown, the apices slightly darker; tibiæ snowy white, with a narrow brownish black ring on basal fifth, together with a much wider (approximately four times) brownish black ring on distal half, this subequal to the white annuli on either side; tarsi white; claws simple, hairy on outer faces (a single leg—posterior—remains). Wings (Plate 1, fig. 12, with a faint brown tinge, the oval stigma dark brown; veins dark brown. Venation: Sc_1 ending about opposite the fork of Rs, Sc_2 some distance before the origin of Rs; Rs shorter than the basal section of R_{4+5} and more nearly straight; m-cu close to fork of M; vein 2d A with the arched portion short.

Abdominal tergites dark brown, the caudal margins of the intermediate segments narrowly ringed with pale, the outer segments more uniformly darkened; sternites with the pale apices more extensive. Ovipositor with the tergal valves nearly straight; hypovalvæ very short.

MINDANAO, Davao district, Mount Apo, Mainit River, altitude 6,000 feet, November 5, 1930 (*Clagg*); holotype, female.

Limonia (*Pseudoglochina*) *bilatior* is quite distinct from all regional species of the subgenus, with the exception of the species next described as *L.* (*P.*) *bilatissima* sp. nov. Both species have the second black ring of the tibiæ very broad and conspicuous, but it is less so in the present fly.

LIMONIA (PSEUDOGLOCHINA) BILATISSIMA sp. nov. Plate 1, fig. 13; Plate 3, fig. 36.

General coloration of mesonotum light brown, the præscutum with a narrow darker median line; pleura yellow, the ventral sclerites darker; tibiæ snowy white, with two black rings, the outer broad, subequal to or exceeding twice the white apex beyond; Sc_1 ending opposite origin or to just beyond midlength of Rs; arched portion of vein 2d A short; abdominal tergites dark brown; male hypopygium with the rostral spines very unequal in size.

Male.—Length, about 5.5 millimeters; wing, 6.5.

Female.—Length, about 5 millimeters; wing, 5.8.

Rostrum yellow; palpi black. Antennæ black throughout; flagellar segments (male) with long apical pedicels; verticils a little exceeding the segments in length; terminal segment elongate, about one-third longer than the penultimate; in female, the verticils are longer and more conspicuous, being approximately twice the segments. Head light brown, the front and anterior vertex more yellowish; a darker brown spot on either side of posterior vertex, adjoining the eyes.

Mesonotum light brown, the præscutum with a slightly darker median line, especially evident in front. Pleura yellow, the ventral sternopleurite dark brown. Halteres brownish yellow, the base of stem clearer yellow, the knobs brownish black. Legs with the fore and middle coxæ brown, the posterior coxæ light yellow; trochanters yellow; femora light brown, at tips passing to darker brown; tibiæ snowy white, with two conspicuous black rings, the outer very broad, exceeding twice the white apex; basal black ring of tibia subequal to or only a little narrower than the white ring immediately beyond it; tarsi white. Wings (Plate 1, fig. 13) grayish subhyaline, the oval stigma pale brown; veins dark brown. Costal fringe relatively long and conspicuous in both sexes. Venation: Sc variable in length, Sc_1 ending opposite the origin to shortly beyond midlength of Rs, the latter short and nearly straight; basal section of R_{4+5} gently arcuated; vein 2d A slightly more arcuated than in *bilatior*.

Abdominal tergites dark brown; sternites dimidiate, their bases brown, the apices broadly yellow. Male hypopygium (Plate 3, fig. 36) with the tergite, *9t*, transverse, the caudal margin very gently emarginate. Dorsal dististyle, *dd*, a strongly curved rod, the apex suddenly narrowed into a straight spine. Ventral dististyle, *vd*, fleshy, the rostral prolongation short, with two very unequal spines, the outer stout, from a very broad, slightly elevated base, the inner spine very slender. Gonapophyses, *g*, pale in color.

LUZON, Tayabas Province, Lucban (*Rivera*); holotype, male, January 24, 1931; allotype, female, January 23, 1931; paratypes, 4 males and females, January 24 to 26, 1931.

Limonia (*Pseudoglochina*) *bilatissima* is most nearly allied to *L.* (*P.*) *bilatior* sp. nov. (Mindanao), differing especially in the details of coloration. The outer black ring of the tibia is here unusually broad, subequal to twice the length of the white apex beyond.

ORIMARGA (ORIMARGA) QUADRILOBATA sp. nov. Plate 1, fig. 14; Plate 3, fig. 37.

General coloration black, sparsely pruinose; antennæ and legs black throughout; wings subhyaline, veins brownish black; Rs strongly angulated at origin; cells beyond cord deep; male hypopygium with the tergal region produced into two conspicuous lobes; basistyle on mesal face at cephalic end bearing a strong lobe that is provided with a dense brush of long setæ; inner dististyle bearing a triangular lobe on outer margin at near two-thirds the length.

Male.—Length, about 5 millimeters; wing, 5.5.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval, becoming progressively smaller to the end; verticils approximately equal in length to the segments. Head gray.

Mesonotum blackish, gray pruinose, the median area of the præscutum broadly of the ground color; centers of scutal lobes similarly blackened. Pleura black, pruinose. Halteres brownish black, the extreme base of stem vaguely brightened. Legs black throughout, the coxæ slightly pruinose. Wings (Plate 1, fig. 14) subhyaline, the veins very distinct, brownish black. Costal fringe of moderate length. Venation: Sc_1 ending just before fork of Rs, Sc_2 at its extreme tip; Rs very strongly angulated at origin; R_{2+3} subequal to the basal section of R_{4+5} and only a little shorter than Rs; cells beyond cord deep; m-cu opposite the point of angulation of Rs; cell 2d A relatively wide.

Abdomen black throughout. Male hypopygium (Plate 3, fig. 37) of very remarkable construction for a member of this usually conservative genus. Region of the tergite, *9t*, on either side produced into a conspicuous lateral lobe that is provided at apex with several powerful setæ; a group of five or six on margin just before apex being longer and more powerful than are the terminal setæ. Basistyle, *b*, with a powerful lobe on mesal face at cephalic end, this lobe bearing a dense brush of long, sinuous setæ that are more or less decussate across the median line with the set of the opposite style. Outer dististyle of normal conformation, a long, slender, gently curved rod that narrows to the acute tip. Inner dististyle, *id*, longer and wider, flattened, on outer margin at near two-thirds the length with a triangular lobe; apex of style beyond this point densely set with retrorse spinous setæ.

MINDANAO, Davao district, Mount Apo, Galog River, altitude 6,000 feet, October 18, 1930 (*Clagg*); holotype, male.

Orimarga (*Orimarga*) *quadrilobata* is entirely distinct from the other described Philippine species of the genus in the venation, especially the elongate R_{2+3}. In the latter regard, it comes closer to a group of species in China, Japan, and Formosa, such being *O.* (*O.*) *formosicola* Alexander, *O.* (*O.*) *fuscivenosa* Alexander, *O.* (*O.*) *omeina* Alexander, *O.* (*O.*) *pruinosa* Alexander, and others, differing most evidently in the very strongly angulated Rs and the complicated structure of the male hypopygium. The latter character serves to separate this fly from all others in Asia that are known to me and where the male sex has been described.

HELIUS (HELIUS) ANÆMICUS sp. nov. Plate 1, fig. 15; Plate 3, fig. 38.

General coloration yellow; head gray; posterior sclerites of mesonotum darkened; knobs of halteres clear light yellow; legs yellow, the tips of femora narrowly and vaguely darkened; wings pale yellow, the costal and apical portions more saturated yellow; cell R_2 open at margin; inner end of cell 1st M_2 arcuated, with r-m at or beyond midlength of the cell; m-cu just before the fork of M; abdominal segments yellow, narrowly ringed on caudal margins with brown; segments 8 and 9 uniformly brown.

Male.—Length, about 4 millimeters; wing, 4.2.

Rostrum light brown, about equal to the remainder of head; palpi dark brown. Antennæ short, brown; basal flagellar segments short and crowded, the first two closely approximated or slightly united; outer segments more elongate, with conspicuous verticils. Head light gray.

Mesonotal præscutum and scutal lobes clear yellow; median region of scutum more infuscated; scutellum testaceous, infuscated medially at base; postnotal mediotergite infuscated. Pleura testaceous yellow, clearer yellow on the ventral sternopleurite. Halteres pale, the knobs clear light yellow. Legs with the coxæ and trochanters yellowish testaceous; femora yellow, the tips very narrowly and vaguely darkened; tibiæ and tarsi pale yellow, the outer tarsal segments brown. Wings (Plate 1, fig. 15) pale yellow, the costal and apical regions more saturated yellow; veins yellow. Costal fringe short; macrotrichia of veins caudad of R_1 very small and few in number, there being short series on both branches of Rs and on the distal half of the outer section of M_{1+2}. Venation: Rs short and straight, about twice the basal section of R_{4+5}; anterior branch of Rs extending generally parallel to vein R_{1+3}, the outer end of cell R_2 being about as extensive as r-m; inner end of cell 1st M_2 strongly arcuated, so r-m lies at or beyond midlength of cell 1st M_2; m-cu shortly before the fork of M.

Abdominal tergites yellow, the caudal fourth or fifth of the segments brown; a subterminal brown ring on segments 8 and 9; hypopygium yellow; sternites similar in pattern, but with the brown a little less intense. Male hypopygium (Plate 3, fig. 38) with the outer dististyle, *od*, relatively small, straight, bidentate at apex. Inner dististyle, *id*, a little longer. Lateral arm of tergite, *9t*, appearing as a conspicuous, pale, compressed blade that is extended into a long, straight, more-sclerotized point.

LUZON, Tayabas Province, Lucban, January 27, 1931 (*Rivera*); holotype, male.

Helius (*Helius*) *anæmicus* is very different from all other regional species of the genus. By my key to the Philippine species of *Helius*[7] the present fly runs to *H.* (*H.*) *argyrosterna* Alexander, which is entirely distinct in the coloration, venation, and structure of the male hypopygium.

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[7] Philip. Journ. Sci. 47 (1932) 184.

HELIUS (EURHAMPHIDIA) SCABIOSUS sp. nov. Plate 1, fig. 16; Plate 3, fig. 39.

Belongs to the *indivisus* group; rostrum relatively long, about equal to the remainder of head; femoral tips broadly snowy white, tibial bases usually brightened, tarsi white; eighth and ninth segments of abdomen brownish black; male hypopygium with the lateral arms of tergite slender, entire; distal portion of outer dististyle with microscopic tubercles.

Male.—Length, about 4.2 to 4.5 millimeters; wing, 5 to 5.3.

Rostrum brown, relatively long, subequal to remainder of head; palpi black. Antennæ black throughout; flagellar segments long-oval, with conspicuous verticils. Head gray.

Mesonotal præscutum dark brown medially, the humeral and lateral regions brighter; posterior sclerites of mesonotum chiefly dark brown. Pleura obscure yellow. Halteres brown, the base of stem restrictedly yellow. Legs with the coxæ and trochanters yellowish testaceous; femora dark brown to black, paler basally, the tips broadly and conspicuously snowy white, the tibial bases less distinctly so whitened; in some cases, including the holotype, the amount of white on bases of tibiæ is much reduced; tibiæ black, the tips conspicuously snowy white, the amount including about the distal fourth or slightly more; tarsi snowy white, with segments 4 and 5, together with the apex of 3, dark brown. Wings (Plate 1, fig. 16) with a faint brownish tinge, the costal region a trifle darker; stigma distinct; veins pale brown. Venation: Sc_1 ending opposite r-m; m variable in length.

Abdominal tergites brown, the sternites obscure yellow; eighth and ninth segments brownish black; hypopygium yellow. Male hypopygium (Plate 3, fig. 39) with the lateral arms of the tergite, *9t*, slender, entire. Outer dististyle, *od*, on distal third or fourth densely set with microscopic tubercles. Inner dististyle terminating in one seta of unusual length and stoutness.

MINDANAO, Davao district, Mati, Mount Mayo, altitude 5,000 feet (*Clagg*); holotype, male, January 28, 1931; paratypes, 2 males, January 30, 1931.

By my key to the Philippine species of *Helius*,[8] the present species runs to couplet 6 which includes its nearest allies, *H.* (*E.*) *indivisus* Alexander (Mindanao) and *H.* (*E.*) *glabristylatus* Alexander (Mindanao), all three forms having the lateral arms of the ninth tergite of the male hypopygium entire and simple and with the tips of the femora broadly white. The present fly is told from *indivisus* by the lack of setulæ on the outer dististyle and from both of the above species by the numerous microscopic tubercles at apex of this style, giving to the organ a scabious or roughened appearance.

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[8] Loc. cit.

HEXATOMINI

Genus EPIPHRAGMA Osten Sacken

Epiphragma OSTEN SACKEN, Proc. Acad. Nat. Sci. Philadelphia for 1859 (1859) 238.

The numerous Philippine species of *Epiphragma* fall naturally within the limits of two subgenera. Of these, the typical subgenus is known only from two species in Mindanao. Elsewhere in the world, *Epiphragma,* s. s., is numerously represented in the Nearctic, Neotropical, Palæarctic, Oriental, and Australasian Regions.

The subgenus *Polyphragma* Alexander[9] is abundantly represented in the Philippines, with more than a score of species described. Representatives have been found only in Luzon and Mindanao, where they are nearly equal in number of discovered forms. Two species, *caninota* and *fuscinota,* have been found in both of these major islands, but most of the remaining species may well prove to be restricted to the island in question. There will undoubtedly be discovered numerous additional forms in the other larger islands of the Archipelago, and likewise in Luzon and Mindanao, which are still insufficiently known. Members of the subgenus have been reported from Borneo but are unknown from the other Malayan islands.

The physical stature of the species is much smaller than usual for the typical subgenus *Epiphragma,* the only one of the Philippine species that at all approaches the latter in size being the subgenotype, *bakeri.* For convenience, I have arranged the known species in five groups, which may be defined briefly as follows:

1. The *bakeri* group. Size large (wing, male, over 10 millimeters); legs almost uniformly darkened. *Epiphragma* (*Polyphragma*) *bakeri.*

2. The *ochrinota* group. Mesonotal præscutum reddish to ocherous, scarcely if at all pruinose, contrasting abruptly with the blackened thoracic pleura. Legs chiefly yellow (except in *fuscofasciata*). *Epiphragma* (*Polyphragma*) *flavosternata,*

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[9] Philip. Journ. Sci. 45 (1931) 435.

E. (*P.*) *fulvinota, E.* (*P.*) *fuscofasciata, E.* (*P.*) *incisuralis, E.* (*P.*) *latitergata, E.* (*P.*) *ochrinota, E.* (*P.*) *parviloba, E.* (*P.*) *riverana,* and *E.* (*P.*) *triarmata.*

3. The *crenulata* group. Dorsum of head and mesonotal præscutum light ashy-gray, the margins of the latter, together with the thoracic pleura, light yellow or fulvous. Axillary lobe or squama often conspicuously developed. Legs chiefly yellow. *Epiphragma* (*Polyphragma*) *angusticrenulata, E.* (*P.*) *caninota, E.* (*P.*) *cinereinota, E.* (*P.*) *crenulata,* and *E.* (*P.*) *griseicapilla.* Position in group of *E.* (*P.*) *subcrenulata* is doubtful.

4. The *fuscosternata* group. Mesonotum patterned with dark brown; thoracic pleura black, variegated with small yellow spots. Legs chiefly yellow (except in *nigrotibiata*). *Epiphragma* (*Polyphragma*) *apoensis, E.* (*P.*) *fuscosternata, E.* (*P.*) *hastata,* and *E.* (*P.*) *nigrotibiata.*

5. The *fuscinota* group. A single dull-colored species, without bright pattern of the body or legs, with very extensive wing cloudings, and with the interbasal process of the male hypopygium a simple spatulate process. *Epiphragma* (*Polyphragma*) *fuscinota.*

The following species of *Polyphragma* are still known only from the female sex and the structure of the interbasal process of the hypopygium cannot be described or figured: *Epiphragma* (*Polyphragma*) *cinereinota, E.* (*P.*) *fuscofasciata, E.* (*P.*) *fuscosternata,* and *E.* (*P.*) *subcrenulata.* The first three surely fall within the limits of the three major groups, as above defined, but the true position of *subcrenulata* is still in doubt. Despite its different coloration, it appears to be correctly placed in the *crenulata* group, the other members of which have the head and mesonotum light ashy-gray.

The chief characters available for the separation of these rather similar flies lie in the general coloration of the body, wings, and legs; in the wing venation, pattern, and conformation, especially the degree of development of the squama in certain species; and in the details of the male hypopygium. Of the latter structures, the tergite and the interbasal process furnish the features most readily to be seen. I have redrawn outlines of the interbase of all species of which the male sex is known at the present time (Plate 4). The commonest type of structure of the interbase is that of a flattened blade that usually bears an outer apical hook. This type of appearance is lost in the species having the interbase a simple acute spine (*hastata,* *ochrinota, parviloba*), and in *fuscinota* which has a simple spatulate head. In other species this hook is variously developed, being almost lost in *flavosternata*.

Key to the Philippine species of Epiphragma Osten Sacken. (Based chiefly on male characters.)

1. A single supernumerary crossvein in cell C of wings; no supernumerary crossvein in cell Cu. (Subgenus *Epiphragma* Osten Sacken.)........ 2.

A series of supernumerary crossveins and spurs of veins in cell C of wings; a more or less distinct crossvein in cell Cu. (Subgenus *Polyphragma* Alexander.) .... 3.

2. Wings with m-cu shortly beyond the fork of M, far before midlength of cell 1st M_2. (Mindanao; Java.) .... *signata* de Meijere.

Wings with m-cu far beyond midlength of cell 1st M_2. (Mindanao.) *distivena* sp. nov.

3. Larger (wing, male, over 10 millimeters); tibiæ uniformly dark brown; (dark wing pattern not bordered by light margins, hypopygium with interbase unequally bidentate at apex (Plate 4, fig. 46). (Luzon.) .... *bakeri* Alexander.

Smaller (wing, male, under 10 millimeters); tibiæ yellow, dark only in *fuscinota, fuscofasciata*, and *nigrotibiata* (wing-pattern of *fuscofasciata* broadly and conspicuously crossbanded with brown; of *nigrotibiata*, the dark areas of wing narrowly bordered by light yellow; of *fuscinota*, the dark areas of wing so extensive as to almost suffuse the entire disk).

4. Mesonotal præscutum light reddish to ocherous, contrasting abruptly with the uniformly blackened thoracic pleura. (*ochrinota* group.) 5.

Mesonotum not patterned as above, thoracic pleura not uniformly blackened .... 13.

5. Wings with a broad, continuous brown crossbanded pattern, including an area at cord and a narrower one at level of origin of Rs; legs with all femora chiefly blackened, the extreme tip pale yellow; tibiæ chiefly blackened, the posterior tibiæ with the distal sixth yellow; fore and middle tarsi dark, posterior tarsi yellow. (Mindanao.) *fuscofasciata* Alexander.

Wings not so crossbanded; legs not as above, the tibiæ and tarsi yellow. 6.

6. Male hypopygium with the interbasal process a slender, simple, acute spine (Plate 4, figs. 57, 58)........ 7.

Male hypopygium with the interbasal process not an acute spine.... 8.

7. Dark pattern of wing narrowly bordered by light yellow; male hypopygium with the tergite having lobes long and narrow, separated by a narrow U-shaped notch. (Luzon.)........ *ochrinota* Alexander.

Dark pattern of wing not bordered by pale; male hypopygium with the tergal lobes very small, separated by a shallow V-shaped notch. (Luzon.) .... *parviloba* Alexander.

8. Dark pattern of wing narrowly bordered by light yellow........ 9.

Dark pattern of wing not bordered by pale........ 12.

9. Femora brown, the tips narrowly pale yellow; male hypopygium with the interbasal process very long and slender, at apex expanded into a flattened blade (Plate 4, fig. 49). (Luzon.)
flavosternata Alexander.

Femora yellow, with a narrow, dark, subterminal ring; male hypopygium with the interbase not as above.. 10.

10. Male hypopygium with the interbasal process having a small curved apical hook but without additional lateral projections or flanges (Plate 4, fig. 55). (Mindanao.)........................ *latitergata* Alexander.

Male hypopygium with the interbase having a small to large lateral flange, in addition to the apical hook.. 11.

11. Interbase with a large conspicuous flange; apical notch of the structure widely open (Plate 4, fig. 60). (Mindanao.)
triarmata Alexander.

Interbase with only a weak lateral flange; apex of structure dilated into a long-oval blade, the apical notch so narrow as to be almost closed (Plate 4, fig. 54). (Luzon.)........................ *incisuralis* sp. nov.

12. Wings pale yellow, the dark pattern restricted in amount; male hypopygium with lateral lobes of tergite small and broad, about as wide as the notch between them; interbasal process very slender (Plate 4, fig. 59). (Luzon.) .... *riverana* sp. nov.

Wings with the ground color infuscated, with a conspicuous darker pattern; male hypopygium with lateral lobes of tergite very slender, spiniform, separated by a very broad U-shaped notch; interbase not conspicuously narrowed (Plate 4, fig. 50). (Mindanao.)
fulvinota Alexander.

13. Mesonotum and dorsum of head clear light gray, contrasting conspicuously with the pale margins of the præscutum and with the pleura (*crenulata* group) .... 14.

Mesonotum and dorsum of head not clear gray.. 18.

14. Wings with axillary lobe only slightly developed, its width narrower than cell 2d A at distal end.. 15.

Wings with axillary lobe conspicuously developed, its width equal to or greater than the width of cell 2d A at distal end........................ 17.

15. Dark wing pattern narrowly ringed with pale yellow; male hypopygium with the interbasal process having the outer hook very deep (Plate 4, fig. 52). (Mindanao.) .... *griseicapilla* Alexander.

Dark wing pattern not ringed with paler; male hypopygium with the interbase having the outer hook slender, separated from the inner lobe by a conspicuous notch (Plate 4, fig. 44). (Male of *cinereinota* unknown.) .... 16.

16. Abdomen with a blackened subterminal ring; ground color of wing light yellow, the dark color restricted in amount but contrasting with the ground; axillary lobe slightly developed. (Luzon.)
cinereinota Alexander.

Abdomen without a blackened subterminal ring; ground color of wing brownish, the dark pattern but little conspicuous against this ground; axillary lobe scarcely developed. (Mindanao.)
angusticrenula Alexander.

17. Dark wing pattern restricted to narrow seams and small marginal spots at ends of longitudinal veins. (Luzon.) *crenulata* Alexander.

Dark wing pattern extensive, with large conspicuous clouds at origin of Rs, along cord, and as marginal areas at ends of longitudinal veins. (Luzon; Mindanao.) .... *caninota* Alexander.

18. Mesonotum and pleura dark brown, variegated with yellow spots; dark areas of wing conspicuously bordered by light yellow. (*fuscosternata* group.) .... 19.

Mesonotum and pleura uniform in color; dark areas of wing not bordered by pale .... 22.

19. Tibiæ black. (Mindanao.) .... *nigrotibiata* Alexander.

Tibiæ uniformly yellow .... 20.

20. Cell 1st M_2 of wings long, the second section of vein M_{1+} exceeding vein M_4; petiole of cell M_1 short, subequal to m. (Luzon.) *fuscosternata* group.

Cell 1st M_2 of wings shorter, the second section of vein M_{1+2} not exceeding vein M_4; petiole of cell M_1 long, subequal to or exceeding m .... 21.

21. Male hypopygium with the interbase a simple acute spine (Plate 4, fig. 53). (Mindanao.) .... *hastata* Alexander.

Male hypopygium with the interbase short and broad, at apex narrowed to a small curved point (Plate 4, fig. 45). (Mindanao.) *apoensis* Alexander.

22. Legs chiefly brown; wing pattern very extensive, the dark coloration nearly suffusing the disk, restricting the ground to small scattered areas. (*fuscinota* group.) (Luzon; Mindanao.) *fuscinota* Alexander.

Legs yellow; wings pale yellow, with a restricted dark pattern. (Luzon.) .... *subcrenulata* Alexander.

The species of *Epiphragma* as they occur in the Philippines, with references to their actual occurrence in the islands, are as follows:

Epiphragma (*Epiphragma*) *distivena* sp. nov.; this report.

Epiphragma (*Epiphragma*) *signata* de Meijere; this report.

Epiphragma (*Polyphragma*) *angusticrenula* Alexander; ALEXANDER, Philippines, XII, Philip. Journ. Sci. 46 (1931) 468–469. (Plate 4, fig. 44.)

Epiphragma (*Polyphragma*) *apoensis* Alexander; ALEXANDER, Philippines, XII, Philip. Journ. Sci. 46 (1931) 462–463. (Plate 4, fig. 45.)

Epiphragma (*Polyphragma*) *bakeri* Alexander; ALEXANDER, Philippines, I, Philip. Journ. Sci. 21 (1922) 373–374; Philippines, X, Philip. Journ. Sci. 46 (1931) 23. (Plate 4, fig. 46.)

Epiphragma (*Polyphragma*) *caninota* Alexander; ALEXANDER, Philippines, XII, Philip. Journ. Sci. 46 (1931) 466–467. (Plate 4, fig. 47.)

Epiphragma (*Polyphragma*) *cinereinota* Alexander; ALEXANDER, Philippines, VIII, Philip. Journ. Sci. **45** (1931) 288–289.

Epiphragma (*Polyphragma*) *crenulata* Alexander; ALEXANDER, Philippines, VII, Philip. Journ. Sci. **43** (1930) 293–294. (Plate 4, fig. 48.)

Epiphragma (*Polyphragma*) *flavosternata* Alexander; ALEXANDER, Philippines, VI, Philip. Journ. Sci. **41** (1930) 304. (Plate 4, fig. 49.)

Epiphragma (*Polyphragma*) *fulvinota* Alexander; ALEXANDER, Philippines, IX, Philip. Journ. Sci. **45** (1931) 436–437. (Plate 4, fig. 50.)

Epiphragma (*Polyphragma*) *fuscinota* Alexander; ALEXANDER, Philippines, IX, Philip. Journ. Sci. **45** (1931) 435–436. (Plate 4, fig. 51.)

Epiphragma (*Polyphragma*) *fuscofasciata* Alexander; ALEXANDER, Philippines, XII, Philip. Journ. Sci. **46** (1931) 459–460.

Epiphragma (*Polyphragma*) *fuscosternata* Alexander; ALEXANDER, Philippines, VI, Philip. Journ. Sci. **41** (1930) 304.

Epiphragma (*Polyphragma*) *griseicapilla* Alexander; ALEXANDER, Philippines, XII, Philip. Journ. Sci. **46** (1931) 467–468. (Plate 4, fig. 52.)

Epiphragma (*Polyphragma*) *hastata* Alexander; ALEXANDER, Philippines, XII, Philip. Journ. Sci. **46** (1931) 464–466. (Plate 4, fig. 53.)

Epiphragma (*Polyphragma*) *incisuralis* sp. nov.; this report. (Plate 4, fig. 54.)

Epiphragma (*Polyphragma*) *latitergata* Alexander; ALEXANDER, Philippines, XII, Philip. Journ. Sci. **46** (1931) 460–462. (Plate 4, fig. 55.)

Epiphragma (*Polyphragma*) *nigrotibiata* Alexander; ALEXANDER, Philippines, XII, Philip. Journ. Sci. **46** (1931) 462–463. (Plate 4, fig. 56.)

Epiphragma (*Polyphragma*) *ochrinota* Alexander; ALEXANDER, Philippines, VI, Philip. Journ. Sci. **41** (1930) 303–304. (Plate 4, fig. 57.)

Epiphragma (*Polyphragma*) *parviloba* Alexander; ALEXANDER, Philippines, X, Philip. Journ. Sci. **46** (1931) 23–24. (Plate 4, fig. 58.)

Epiphragma (*Polyphragma*) *riverana* sp. nov.; this report. (Plate 4, fig. 59.)

Epiphragma (*Polyphragma*) *subcrenulata* Alexander; ALEXANDER, Philippines, VIII, Philip. Journ. Sci. **45** (1931) 287–288.

Epiphragma (*Polyphragma*) *triarmata* Alexander; ALEXANDER, Philippines, IX, Philip. Journ. Sci. **45** (1931) 437–438. (Plate 4, fig. 60.)

The above references to figs. 45 to 60, inclusive, are comparison figures of the interbasal processes of the various species of *Polyphragma*.

EPIPHRAGMA (EPIPHRAGMA) SIGNATA (de Meijere).

Ephiphragma (sic) *signata* DE MEIJERE, Tijdschr. v. Entomol. 54 (1911) 52, pl. 4, fig. 43.

Described from Java. One male, La Lun Mountains, Calian, Davao district, Mindanao, altitude 5,300 feet, July 3, 1930 (*Clagg*).

EPIPHRAGMA (EPIPHRAGMA) DISTIVENA sp. nov. Plate 1, fig. 17; Plate 3, fig. 40.

General coloration ocherous-yellow, the ground color of the præscutum dark brown; pleura variegated with brownish black areas; femora fulvous brown, becoming slightly darker before the narrow yellow tips; wings whitish subhyaline, with an ocellate and banded brown pattern, the areas ocher-yellow, bordered with darker; cell R_3 relatively short, m-cu lying far distad; male hypopygium with the interbase a slender sclerotized rod, the apical third flexible and bent at an angle to the remainder of the rod.

Male.—Length, about 14 millimeters; wing, 13.8.

Rostrum ocher-yellow; basal three segments of maxillary palpi pale yellow, terminal segment uniformly darkened. Antennæ with the scape dark brown; pedicel reddish brown; basal segment of flagellum yellow, the remainder black; flagellar segments cylindrical, with long verticils that slightly exceed the segments; if bent backwards, the antennæ extend to near middistance between the bases of the wings and halteres. Head buffy.

Pronotum yellow, the anterior notum narrowly trivittate with dark brown. Mesonotal præscutum with the ground color dark brown, the four usual stripes extensive, the laterals confluent with the intermediate pair near their anterior ends, isolating the posterior interspaces; intermediate stripes confluent, except for a capillary black vitta on anterior third of sclerite; scutum fulvous-brown, the lobes more or less darkened; scutellum black medially, the margin obscure yellow; postnotal mediotergite with a yellow pollen, variegated with brown on both caudal and cephalic ends. Pleura yellowish white, variegated with small brownish black areas on propleura, two or three on anepisternum, ventral sternopleurite, ventral pteropleurite, and dorsal pleurotergite. Halteres yellow, the distal portion of stem and base of knob a little darkened. Legs with the coxæ light yellow, the fore coxæ with a narrow brown girdle at near midlength, the middle and posterior coxæ narrowly darkened at both base and apex; trochanters yellow; femora fulvous-brown, becoming somewhat darker just before the narrow yellow tips; tibiæ and tarsi yellow, the terminal segments of the latter broken. Wings (Plate 1, fig. 17) whitish subhyaline, with an ocellate and banded pattern that is almost exactly as in *klossi;* areas rich ocher-yellow, bordered with darker; veins yellow, darker in the clouded areas. Venation: Supernumerary cross-vein in cell C long and very oblique; anterior branch of Rs ($R_{2+3}+R_3$) shorter than cell 1st M_2; m-cu lying far distad, at near three-fifths the length of the cell.

Abdominal tergites with the basal ring fulvous, variegated laterally with dark brown triangles; posterior ring dark brown, conspicuously bordered laterally and caudally with whitish; sternites more uniformly yellow. Male hypopygium (Plate 3, fig. 40) with the interbase, *i,* a slender, sclerotized rod, the distal third flexible, bent at an angle to the axis of the rod.

MINDANAO, Davao district, Mount Apo, Seliban River, altitude 7,000 feet, September 11, 1930 (*Clagg*) ; holotype, male.

In its general appearance, wing pattern, and venation, *Epiphragma* (*Epiphragma*) *distivena* is most nearly allied to *E.* (*E.*) *klossi* Brunetti (Federated Malay States), differing most evidently in the pale femora, these being entirely black in *klossi.* The structure of the interbases is very different from that of all species found in Japan and Formosa.

EPIPHRAGMA (POLYPHRAGMA) FUSCOFASCIATA Alexander.

Epiphragma (*Polyphragma*) *fuscofasciata* ALEXANDER, Philip. Journ. Sci. 46 (1931) 459–460.

Additional specimens show the leg pattern much more distinctly than did the original type material. This arrangement of color on the various legs is quite different from that found in the other species of *Polyphragma.* All femora chiefly blackened, the extreme tips pale yellow; fore and middle tibiæ black, the base narrowly yellow; hind tibiæ similar, the distal sixth paling to yellow; fore and middle tarsi black, the posterior tarsi yellow.

One female, Galog River, Mount Apo, Mindanao, altitude 6,000 feet, October 22, 1930; 1 female, La Lun Mountains, Calian, Davao district, Mindanao, altitude 5,500 feet, January 2, 1931 (*Clagg*).

EPIPHRAGMA (POLYPHRAGMA) INCISURALIS sp. nov. Plate 1, fig. 18; Plate 3, fig. 41; Plate 4, fig. 54.

Belongs to the *ochrinota* group; mesonotum pale brownish ocherous, sparsely pruinose; pleura and sternum dark brown; femora yellow, with a broad brown subterminal ring; wings with the dark brown pattern narrowly ringed with clear yellow; inner end of cell R_4 lying basad of that of cell R_5; male hypopygium with the inner dististyle angularly bent beyond midlength; interbase expanded into an oval blade at apex, terminating in a small hook, the blade subtended by a low flange.

Male.—Length, about 6.5 millimeters; wing, 7.3.

Rostrum dark brown; basal segment of palpus pale brown, the outer segments brownish black. Antennæ with the scape, pedicel, and basal three flagellar segments yellow, the remainder dark brown. Head with the central portion of vertex extensively dark brown, the lateral portions and orbits more reddish, the surface sparsely pruinose.

Mesonotum pale brownish ocherous, the lateral portions of of præscutum more chestnut-brown; surface of notum sparsely pruinose. Pleura and sternum uniformly dark brown, contrasting abruptly with the pale yellow coxæ. Halteres pale yellow, the knobs dark brown. Legs with the coxæ pale yellow, their bases conspicuously dark brown, more broadly so on posterior coxæ; trochanters yellow; femora yellow, with a broad brown subterminal ring; tibiæ and tarsi yellow. Wings (Plate 1, fig. 18) with the ground color pale brown, the prearcular and costal regions clear yellow; a heavy and conspicuous brown pattern that is narrowly bordered by clear yellow; major dark areas at arculus, origin of Rs, along cord, outer end of cell 1st M_2, and as a marginal series at ends of all longitudinal veins, deeper and more intensely brown in the costal and apical portions, becoming more diffuse in the cubital and anal fields; costal crossveins and spurs about six in number; veins dark brown, paler in the clear areas. No axillary crenulation. Venation: Rs relatively long; R_{2+3+4} about twice the basal section of R_5; inner end of cell R_4 lying basad of that of cell R_5; m-cu between one-third and one-half its length beyond the fork of M; supernumerary crossvein in cell Cu distinct.

Abdominal tergites dark brown; hypopygium dark. Male hypopygium (Plate 3, fig. 41) with the tergal lobes, 9*t*, broad, separated by a median notch that is a little narrower at apex than either lobe. Outer dististyle, *od*, slender, the apex weakly and unequally bidentate. Inner dististyle longer, at about two-thirds the length bent at a strong angle into a flattened blade. Interbase (Plate 4, fig. 54, *i*) with the proximal portion large and powerful, at apex expanded into a flattened blade, the apical hook of which is separated from the main body of the blade by a small oval to subcircular incision that is closed; on outer face of rod, extending to base of the oval expansion is a low flange.

LUZON, Tayabas Province, Lucban, January 23, 1931 (*Rivera*); holotype, male.

The nearest described ally of the present fly is *Epiphragma (Polyphragma) triarmata* Alexander (Mindanao), which has a somewhat similar wing pattern and condition of the ninth tergite and dististyles of the male hypopygium, but an entirely different interbasal process.

EPIPHRAGMA (POLYPHRAGMA) RIVERANA sp. nov. Plate 1, fig. 19; Plate 3, fig. 42; Plate 4, fig. 59.

Belongs to the *ochrinota* group; mesonotum light reddish brown, the pleura and sternum dark brown; legs yellow, the femur with a broad subterminal brown ring; wings with the ground color almost uniformly pale yellow, with relatively small brown spots; male hypopygium with the lobes of the tergite small, triangular in outline, separated by a U-shaped notch; interbase elongate, a little expanded at apex, terminating in a small curved point.

Male.—Length, about 6 millimeters; wing, 7.

Rostrum and palpi dark brown. Antennæ with the scape, pedicel, and basal two flagellar segments yellow to fulvous, the remainder brownish black. Head brownish black medially, the sides of the posterior vertex reddish brown, the surface very sparsely pruinose.

Mesonotum light reddish brown, the scutellum and postnotal mediotergite darker and sparsely pruinose. Pleura and sternum dark brown, contrasting abruptly with the yellow coxæ. Halteres yellow, the knobs dark brown. Legs yellow, the posterior coxæ darkened at bases; femora with a broad brown subterminal ring. Wings (Plate 1, fig. 19) with the ground color almost uniform pale yellow to grayish yellow, variegated with restricted brown spots that do not form bands or extensive areas; darkened spots at arculus, origin of Rs, cord, outer end of cell 1st M_2, fork of M_{1+2}, and marginal clouds at ends of all longitudinal veins, those of the radial field larger and more distinct. Venation: m-cu variable in position, from close to fork of M to nearly its own length beyond this fork.

Abdominal tergites light brown, margined caudally and laterally with dark brown; sternites clearer yellow, the caudal margins narrowly dark brown; hypopygium dark brown. Male hypopygium (Plate 3, fig. 42) with the lobes of the tergite, 9*t*, small, triangular in outline, separated by a U-shaped notch. Interbase (Plate 4, fig. 59, *i*) relatively long and slender, at apex a little expanded and terminating in a small curved point.

LUZON, Tayabas Province, Lucban (*Rivera*); holotype, male, January 23, 1931; paratypes, 3 males, January 24 and 25, 1931.

Epiphragma (*Polyphragma*) *riverana* is named in honor of Mr. Francisco Rivera, whose collections of Tipulidæ in many parts of the Philippines have added very materially to our knowledge of the subject. The present fly is most closely allied to *E.* (*P.*) *parviloba* Alexander (Luzon), differing most conspicuously in the structure of the interbasal process of the male hypopygium, which, in *parviloba*, is a long, acutely pointed spine.

Genus LIMNOPHILA Macquart

Limnophila MACQUART, Suit. à Buffon 1 (1834) 95.

The Philippine species of the genus *Limnophila* belong to three subgenera. The typical subgenus *Limnophila* (*Poecilostola*, syn.) has four species that fall into two groups, based on the structure of the gonapophyses. *Limnophila* (*Limnophila*) *petulans* is allied to species such as *L.* (*L.*) *aino* Alexander (northern Japan), *L.* (*L.*) *dicranophragmoides* Alexander (Riukiu Islands), and *L.* (*L.*) *murudensis* Edwards (Borneo). *Limnophila* (*L.*) *benguetana*, *L.* (*L.*) *bituminosa*, and *L.* (*L.*) *subguttularis* find their nearest ally in the Bornean *L.* (*L.*) *guttularis* Edwards. Elsewhere, members of the typical subgenus are chiefly Palæarctic in distribution, but there are, in many regions of the world, numerous species of the genus whose strict position in subgenera is still in question.

The single local species of *Elæophila* (*Ephelia*, syn.) finds its near ally in *L.* (*E.*) *granulata* Edwards (Borneo), with the other members of the subgenus widely spread over the Holarctic Region. The three closely allied species of *Dicranophragma* are nearly allied to the Javan *L.* (*D.*) *remota* (de Meijere) in the long costal fringe of the male and the retracted position of the supernumerary crossvein in cell R_3. All three Philippine species of this subgenus have the mesonotum unmarked, or virtually so. Elsewhere, members of this subgenus occur only in the eastern Nearctic, eastern Palæarctic and Oriental Regions.

Key to the Philippine species of Limnophila Macquart. (Based in part on male characters.)

1. Wings without supernumerary crossveins in the cells. (Subgenus *Limnophila* Macquart.) .... 2.

Wings with a supernumerary crossvein in cell R_3 or in cell M.......... 5.

2. Legs yellow, the femora with a faint, ill-defined, subterminal brown ring; wing pattern consisting of an abundance of dots and spots, the major areas being in part ocelliform (origin of Rs and along cord); male hypopygium with the gonapophyses appearing as flattened, paddlelike blades. (Mindanao.).......... *petulans* Alexander.

Legs brown or black; if yellow (*subguttularis*), the tips of the femora and tibiæ narrowly blackened; wing pattern not ocelliform, chiefly restricted to the vicinity of the veins; male hypopygium with the gonapophyses not appearing as flattened blades, their tips terminating in acute spines .... 3.

3. Legs yellow, the tips of the femora and tibiæ narrowly dark brown; wings with numerous brown dots in the medial field. (Mindanao.) *subguttularis* sp. nov.

Legs chiefly brown or black, especially the tibiæ; wings without isolated brown dots in the outer medial field.......... 4.

4. Wings with the dark pattern restricted, the yellow interspaces being much broader than the darkened areas; male hypopygium with the gonapophyses appearing as long, slender points. (Luzon.) *benguetana* Alexander.

Wings with the ground color much restricted by a dark pattern, the latter areas being equal or greater in extent than the yellow interspaces; male hypopygium with the gonapophyses appearing as flattened blades with only the relatively short apices narrowed into points. (Mindanao.) .... *bituminosa* Alexander.

5. A supernumerary crossvein in cell M of wings. (Subgenus *Elæophila* Rondani.) (Luzon; Mindanao.) .... *igorota* Alexander.

A supernumerary crossvein in cell R_3 of wings. (Subgenus *Dicranophragma* Osten Sacken.) .... 6.

6. Wings with the darkened areas in outer radial cells large and nearly confluent; spots in cells M, Cu, 1st A, and 2d A tending to form parallel cross-lines. (Mindanao.) .... *radialis* Alexander.

Wings without large and nearly confluent areas filling the outer radial cells; spots in cells Cu, 1st A, and 2d A small, spotlike, not forming cross-lines .... 7.

7. Halteres with the knobs infuscated; wing pattern very abundantly spotted and dotted with brown in all interspaces; markings along caudal margin tending to form small but distinct circles. (Luzon.) *pardalota* Alexander.

Halteres light yellow; wing pattern more restricted, with relatively sparse brown dots in the interspaces between the major dark areas; marginal areas solid, not forming circles. (Mindanao.)
retracta Alexander.

A list of the Philippine species of *Limnophila*, with references to occurrence, is as follows:

Limnophila (*Limnophila*) *benguetana* Alexander; ALEXANDER, Philippines, VIII, Philip. Journ. Sci. 45 (1931) 289–290.

Limnophila (*Limnophila*) *bituminosa* Alexander; ALEXANDER, Philippines, XIII, Philip. Journ. Sci. 47 (1932) 189–190.

Limnophila (*Limnophila*) *petulans* Alexander; ALEXANDER, Philippines, XIV, Philip. Journ. Sci. 48 (1932) 38–39.

Limnophila (*Limnophila*) *subguttularis* sp. nov.; this report.

Limnophila (*Elæophila*) *igorota* Alexander; ALEXANDER, Philippines, X, Philip. Journ. Sci. 46 (1931) 24–25.

Limnophila (*Dicranophragma*) *pardalota* Alexander; ALEXANDER, Philippines, VIII, Philip. Journ. Sci. 45 (1931) 291.

Limnophila (*Dicranophragma*) *radialis* Alexander; ALEXANDER, Philippines, IX, Philip. Journ. Sci. 45 (1931) 440–441.

Limnophila (*Dicranophragma*) *retracta* Alexander; ALEXANDER, Philippines, IX, Philip. Journ. Sci. 45 (1931) 439–440.

LIMNOPHILA (LIMNOPHILA) SUBGUTTULARIS sp. nov. Plate 1, fig. 20; Plate 3, fig. 43.

General coloration dark brown, with a sparse yellow pollinosity; median region of præscutum elevated into a series of weak tubercles; halteres pale yellow; legs yellow, the tips of femora and tibiæ narrowly blackened, more broadly so on the former; wings light yellow, with a conspicuous brown spotted and dotted pattern, the smaller dots being most abundant throughout the whole length of the medial field; male hypopygium with the apex of each gonapophysis suddenly narrowed into a slender beak.

Male.—Length, about 5.8 millimeters; wing, 6.5.

Female.—Length, about 6 millimeters; wing, 6.3.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval with verticils that are fully twice as long as the segments bearing them. Head yellowish brown, the center of the vertex darker brown.

Mesonotum dark brown, with a sparse yellow pollen, leaving traces of three brown stripes; median line of præscutum elevated into weak tubercles, this identical in both sexes and apparently a normal condition; posterior sclerites of mesonotum dark, sparsely pollinose. Pleura black, sparsely pollinose, with indications of narrow, darker, longitudinal stripes across the anepisternum and ventral sternopleurite. Halteres pale yellow.

Legs with the coxæ and trochanters black, sparsely pollinose; femora and tibiæ yellow, the tips very narrowly darkened, more broadly so on the femora; tarsi yellow, the tips of the individual segments narrowly darkened, the terminal two segments uniformly infuscated; legs conspicuously hairy. Wings (Plate 1, fig. 20) with the ground color light yellow, with a conspicuous brown spotted and dotted pattern, including about five major areas, that at the cord nearly continuous across the wing; numerous small dots distributed over the entire length of the medial field; costal cell with a variable number of small spots, additional to the larger costal areas; veins yellow, darker in the infuscated areas. Costal fringe (male) relatively long and conspicuous. Venation: R_2 very faint; m-cu at near midlength of cell 1st M_2.

Abdomen brownish black, including the hypopygium. Male hypopygium (Plate 3, fig. 43) with the outer dististyle, *od*, simple, narrowed to an acute tip, the surface with numerous short setæ. Gonapophyses, *g*, appearing as gently curved pale blades that narrow suddenly before their tips into a slender beaklike portion, before this narrowed portion, on outer margin, with a small denticle. Ædeagus slender, curved at apex.

MINDANAO, Davao district, Mati, Mount Mayo, altitude 5,000 feet (*Clagg*); holotype, male, January 27, 1931; allotype, female, January 30, 1931.

The closest ally of *Limnophila* (*Limnophila*) *subguttularis* appears to be *L.* (*L.*) *guttularis* Edwards (Borneo), which differs in the less conspicuously spotted wings, the outer medial field being free from darkened areas except those along cord, outer end of cell 1st M_2 and at fork of vein M_{1+2}. The darkened tips of the tibiæ are more extensive than those of the femora in *guttularis*, the reverse condition being true in the present species. The Bornean fly differs further in having the pedicel of the antenna paler than the remainder of the organ and with the abdominal sternites pale.

Genus PILARIA Sintenis

Pilaria SINTENIS, Sitzgsber. Naturf. Gesell. Dorpat 8 (1888) 398.

A few species of the typical subgenus *Pilaria* occur in the Philippines, in addition to about an equal number of the endemic group *Eupilaria*. Elsewhere in the world, *Pilaria* s. s. is widely spread throughout the Holarctic and Oriental Regions, with fewer species in the Neotropical and Ethiopian Regions.

Key to the Philippine species of Pilaria Sintenis. (Based in part on male characters.)

1. Cell M_1 lacking; anterior branch of Rs very short, less than one-half R_4, cell R_3 at wing margin being very wide, exceeding four times that of cell R_2; antennæ short in both sexes. (Subgenus *Eupilaria* Alexander.) .... 2.
   Cell M_1 present; anterior branch of Rs elongate, exceeding two-thirds of R_4, cell R_3 at wing margin of normal width, subequal to cell R_2; antennæ (male) elongate. (Subgenus *Pilaria* Sintenis.) .... 4.
2. Tarsi conspicuously white. (Mindanao.) .... *leucopoda* Alexander.
   Tarsi black .... 3.
3. Male hypopygium with the outer dististyle very slender, much narrower than the inner style, subequal in diameter or more slender than the gonapophyses; tergite with low irregular lobes that are separated by a broad U-shaped notch. (Mindanao.) .... *auranticolor* Alexander.
   Male hypopygium with the outer dististyle broad, exceeding one-half the width of the inner style and much wider than the gonapophyses; tergite with two submedian lobes that are separated by a linear notch. (Luzon.) .... *phœnosoma* Alexander.
4. Posterior tarsi conspicuously whitened. (Luzon; Mindanao.) *alboposticata* Alexander.
   Tarsi uniformly pale brown to dark brown .... 5.
5. Mesonotum polished black, the thoracic pleura abruptly yellow. (Luzon; Mindanao.) .... *carbonipes carbonipes* Alexander.
   Mesonotum and pleura entirely polished black. (Mindanao.) *carbonipes holomelania* Alexander.

The Philippine members of *Pilaria*, with references to their occurrence in the islands, are as follows:

Pilaria (*Eupilaria*) *auranticolor* Alexander; ALEXANDER, Philippines, XIV, Philip. Journ. Sci. 48 (1932) 39–40.

Pilaria (*Eupilaria*) *leucopoda* Alexander; ALEXANDER, Philippines, XIII, Philip. Journ. Sci. 47 (1932) 190–191.

Pilaria (*Eupilaria*) *phœnosoma* Alexander; ALEXANDER, Philippines, X, Philip. Journ. Sci. 46 (1931) 25–27.

Pilaria (*Pilaria*) *alboposticata* Alexander; ALEXANDER, Philippines, X, Philip. Journ. Sci. 46 (1931) 28; this report.

Pilaria (*Pilaria*) *carbonipes carbonipes* Alexander; ALEXANDER, Philippines, X, Philip. Journ. Sci. 46 (1931) 27–28; this report.

Pilaria (*Pilaria*) *carbonipes holomelania* Alexander; ALEXANDER, Philippines, X, Philip. Journ. Sci. 46 (1931) 28.

PILARIA (PILARIA) ALBOPOSTICATA Alexander.

Pilaria alboposticata ALEXANDER, Philip. Journ. Sci. 46 (1931) 28.

Described from Luzon. One male, Mainit River, Mount Apo, Davao district, Mindanao, altitude 6,000 feet, September 9, 1930 (*Clagg*).

PILARIA (PILARIA) CARBONIPES CARBONIPES Alexander.

Pilaria carbonipes ALEXANDER, Philip. Journ. Sci. 46 (1931) 27–28.

Described from Luzon. What seem to be exactly the same race are from various stations on Mount Apo, Davao district, Mindanao. Mainit River, altitude 6,000 feet, September 22, 1930; Kidopawan trail from Lake Lino, altitude 7,000 to 8,000 feet, September 30, 1930; Lake Lino, altitude 8,000 feet, September 19, 1930 (*Clagg*).

ERIOPTERINI

TRENTEPOHLIA (MONGOMA) FULVINOTA sp. nov. Plate 1, fig. 21.

General coloration of mesonotum light fulvous-yellow; head dark, the posterior vertex weakly carinate; antennal verticils short; legs brownish black, the tarsi paling to yellow; wings cream-colored, the stigma small but distinct; R_{3+4} short but distinct; inner ends of cells R_5 and M_3 nearly in alignment.

Male.—Length, about 6 millimeters; wing, 7.

Female.—Length, about 6.5 millimeters; wing, 7.

Rostrum brown, the palpi black. Antennæ black throughout; flagellar segments long-oval to subcylindrical, with verticils that are shorter than the segments. Head brownish black, the anterior vertex narrow, the posterior vertex carinate medially.

Cervical sclerites black. Mesonotum light fulvous yellow, in cases with the posterior sclerites slightly more infuscated. Pleura obscure yellow, the dorsopleural region and ventral sternopleurite very weakly darkened. Halteres dark brown, the base of stem restrictedly yellow. Legs with the coxæ brownish yellow; trochanters obscure yellow; femora brownish black, paler at bases; tibiæ and most of basitarsi brownish black, the remainder of tarsi paling to obscure yellow; posterior tibiæ with a single enlarged spinous seta at apex; proximal end of basitarsi with a dense grouping of the ordinary setæ. Wings (Plate 1, fig. 21) with a creamy tinge, the prearcular and costal regions clearer yellow; stigma small but distinct; veins dark brown, some, especially the posterior cord, vaguely seamed with darker. Venation: R_2 from three to four times as long as R_{3+4}; inner ends of cells R_5 and M_3 nearly in transverse alignment; m-cu at or close to fork of M; fusion of veins Cu_1 and 1st A short.

Abdominal tergites dark brown, the caudal portions of the segments narrowly brownish black, the extreme edges pale; basal sternites brownish yellow; hypopygium brownish black. Ovipositor with the genital shields obscure yellow, cerci relatively elongate, horn-brown.

MINDANAO, Davao district, Mount Apo (*Clagg*); holotype, male, altitude 7,000 to 8,000 feet, Kidapawan trail from Lake Lino, September 20, 1930; allotype, female, altitude 6,000 feet, Baroring River, November 10, 1930; paratopotype, male, with the holotype; paratypes, 2 males, with the allotype; 1 male, altitude 6,500 feet, Sibulan River, September 1, 1930; 6 males and females, La Lun Mountains, altitude 5,500 feet, July 2, 1930, December 31, 1930, January 1, 1931.

By my key to the Philippine species of *Trentepohlia*,[10] the present species runs to couplet 8, agreeing most closely with *T.* (*M.*) *riverai* Alexander (Luzon) which differs in the small size, dark brown coloration, and the details of venation, as the less erect R_3, with cell R_2 at margin correspondingly much wider.

TRENTEPOHLIA (MONGOMA) TENEROIDES sp. nov. Plate 1, fig. 22.

General coloration of mesonotum dark brown; rostrum brownish black; antennæ black, the flagellar segments without modified verticils; legs elongate, black, the tips of the femora narrowly, of the tibiæ more broadly whitened; tarsi white; wings with a faint brown tinge, cells C and Sc blackened; inner end of cell M_3 lying proximad of the other cells that lie at outer end of cell 1st M_2.

Male.—Length, about 9 millimeters; wing, 8.5.

Female.—Length, about 8.5 millimeters; wing, 8.

Rostrum and palpi brownish black. Antennæ black throughout; flagellar segments subcylindrical, with short verticils. Head black, sparsely pruinose; anterior vertex narrow; posterior vertex carinate.

Pronotum dark brown. Mesonotal præscutum and centers of scutal lobes dark brown, the median region of scutum obscure yellow; scutellum and postnotum darkened medially, paler on sides. Pleura obscure yellow, infuscated on the anepisternum and dorsal sternopleurite. Halteres blackened. Legs with the fore and middle coxæ infuscated, the posterior coxæ paler; trochanters obscure yellow; femora black, the tips narrowly but conspicuously white; tibiæ dark brown, the tips broadly whitened; tarsi white, the proximal ends of basitarsi a little infumed; legs very long and slender (male, hind leg, femur, 16.3 millimeters; tibia, 17; tarsus, 10); femora (fore legs missing) with a series of long setæ on lower face, these longest at proximal end of segment, becoming progressively smaller outwardly. Wings (Plate 1, fig. 22) with a faint brown tinge; cells C and Sc conspicuously blackened; wing margin in outer radial field vaguely darkened; veins brown. Venation: Rs subequal to or a little longer than basal section of R_5 and somewhat more than one-half R_{2+3+4}; R_{3+4} distinct but variable in length, shorter than R_2; veins R_3 and R_4 not strongly divergent; inner end of cell M_3 lying far proximad of the other cells that lie at outer end of cell 1st M_2; m-cu at or close to fork of M; apical fusion of veins Cu_1 and 1st A slight.

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[10] Philip. Journ. Sci. 43 (1930) 297–298.

Abdominal tergites dark brown; sternites similar, vaguely brightened laterally.

MINDANAO, Davao district, Mount Apo (*Clagg*); holotype, male, altitude 6,500 feet, Mainit River, September 14, 1930; allotype, female, altitude 7,000 feet, Baroring River, November 9, 1930.

By my key to the Philippine species of *Trentepohlia*,[11] the present fly runs to couplet 5, disagreeing with both included forms, *saxatilis* Alexander and *tenera* (Osten Sacken), in the darkened tibiæ. I consider that *tenera* is the closest ally of the present species, which is distinguished by the darkened tibiæ and the darkened costal margin of the wing.

[11] Loc. cit.

ILLUSTRATIONS

[Legend: *a*, ædeagus; *b*, basistyle; *dd*, dorsal dististyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *t*, 9th tergite; *vd*, ventral dististyle.]

PLATE 1

FIG. 1. *Tipula* (*Indotipula*) *latilobata* sp. nov., wing.
2. *Tipula* (*Indotipula*) *angustilobata* sp. nov., wing.
3. *Tipula* (*Tipulodina*) *varitarsis* sp. nov., wing.
4. *Tipula* (*Tipulodina*) *deprivata* sp. nov., wing.
5. *Limonia* (*Limonia*) *capella* sp. nov., wing.
6. *Limonia* (*Limonia*) *brachyneura* sp. nov., wing.
7. *Limonia* (*Limonia*) *browni* sp. nov., wing.
8. *Limonia* (*Dicranomyia*) *suborthia* sp. nov., wing.
9. *Limonia* (*Dicranomyia*) *orthioides* sp. nov., wing.
10. *Limonia* (*Rhipidia*) *servilis* sp. nov., wing.
11. *Limonia* (*Euglochina*) *captiosa* sp. nov., wing.
12. *Limonia* (*Pseudoglochina*) *bilatior* sp. nov., wing.
13. *Limonia* (*Pseudoglochina*) *bilatissima* sp. nov., wing.
14. *Orimarga* (*Orimarga*) *quadrilobata* sp. nov., wing.
15. *Helius* (*Helius*) *anæmicus* sp. nov., wing.
16. *Helius* (*Eurhamphidia*) *scabiosus* sp. nov., wing.
17. *Epiphragma* (*Epiphragma*) *distivena* sp. nov., wing.
18. *Epiphragma* (*Polyphragma*) *incisuralis* sp. nov., wing.
19. *Epiphragma* (*Polyphragma*) *riverana* sp. nov., wing.
20. *Limnophila* (*Limnophila*) *subguttularis* sp. nov., wing.
21. *Trentepohlia* (*Mongoma*) *fulvinota* sp. nov., wing.
22. *Trentepohlia* (*Mongoma*) *teneroides* sp. nov., wing.

PLATE 2

FIG. 23. *Tipula* (*Indotipula*) *latilobata* sp. nov., antenna, basal seven segments.
24. *Tipula* (*Indotipula*) *latilobata* sp. nov., male hypopygium, details.
25. *Tipula* (*Indotipula*) *manobo* sp. nov., male hypopygium, details.
26. *Tipula* (*Indotipula*) *ubensis* sp. nov., male hypopygium, details.
27. *Tipula* (*Indotipula*) *ifugao* sp. nov., male hypopygium, details.
28. *Tipula* (*Indotipula*) *angustilobata* sp. nov., antenna, basal seven segments.
29. *Tipula* (*Indotipula*) *angustilobata* sp. nov., male hypopygium, details.
30. *Tipula* (*Tipulodina*) *varitarsis* sp. nov., male hypopygium, styli.
31. *Limonia* (*Limonia*) *capella* sp. nov., male hypopygium.
32. *Limonia* (*Limonia*) *brachyneura* sp. nov., male hypopygium.

PLATE 3

FIG. 33. *Limonia* (*Limonia*) *browni* sp. nov., male hypopygium.
34. *Limonia* (*Dicranomyia*) *suborthia* sp. nov., male hypopygium.
35. *Limonia* (*Rhipidia*) *servilis* sp. nov., male hypopygium.
36. *Limonia* (*Pseudoglochina*) *bilatissima* sp. nov., male hypopygium.
37. *Orimarga* (*Orimarga*) *quadrilobata* sp. nov., male hypopygium.
38. *Helius* (*Helius*) *anæmicus* sp. nov., male hypopygium.
39. *Helius* (*Eurhamphidia*) *scabiosus* sp. nov., male hypopygium.
40. *Epiphragma* (*Epiphragma*) *distivena* sp. nov., male hypopygium.
41. *Epiphragma* (*Polyphragma*) *incisuralis* sp. nov., male hypopygium.
42. *Epiphragma* (*Polyphragma*) *riverana* sp. nov., male hypopygium.
43. *Limnophila* (*Limnophila*) *subguttularis* sp. nov., male hypopygium.

PLATE 4

FIG. 44. *Epiphragma* (*Polyphragma*) *angusticrenula* Alexander, male hypopygium, interbasal process.
45. *Epiphragma* (*Polyphragma*) *apoensis* Alexander, male hypopygium, interbasal process.
46. *Epiphragma* (*Polyphragma*) *bakeri* Alexander, male hypopygium, interbasal process.
47. *Epiphragma* (*Polyphragma*) *caninota* Alexander, male hypopygium, interbasal process.
48. *Epiphragma* (*Polyphragma*) *crenulata* Alexander, male hypopygium, interbasal process.
49. *Epiphragma* (*Polyphragma*) *flavosternata* Alexander, male hypopygium, interbasal process.
50. *Epiphragma* (*Polyphragma*) *fulvinota* Alexander, male hypopygium, interbasal process.
51. *Epiphragma* (*Polyphragma*) *fuscinota* Alexander, male hypopygium, interbasal process.
52. *Epiphragma* (*Polyphragma*) *griseicapilla* Alexander, male hypopygium, interbasal process.
53. *Epiphragma* (*Polyphragma*) *hastata* Alexander, male hypopygium, interbasal process.
54. *Epiphragma* (*Polyphragma*) *incisuralis* sp. nov., male hypopygium, interbasal process.
55. *Epiphragma* (*Polyphragma*) *latitergata* Alexander, male hypopygium, interbasal process.
56. *Epiphragma* (*Polyphragma*) *nigrotibiata* Alexander, male hypopygium, interbasal process.
57. *Epiphragma* (*Polyphragma*) *ochrinota* Alexander, male hypopygium, interbasal process.
58. *Epiphragma* (*Polyphragma*) *parviloba* Alexander, male hypopygium, interbasal process.
59. *Epiphragma* (*Polyphragma*) *riverana* sp. nov., male hypopygium, interbasal process.
60. *Epiphragma* (*Polyphragma*) *triarmata* Alexander, male hypopygium, interbasal process.

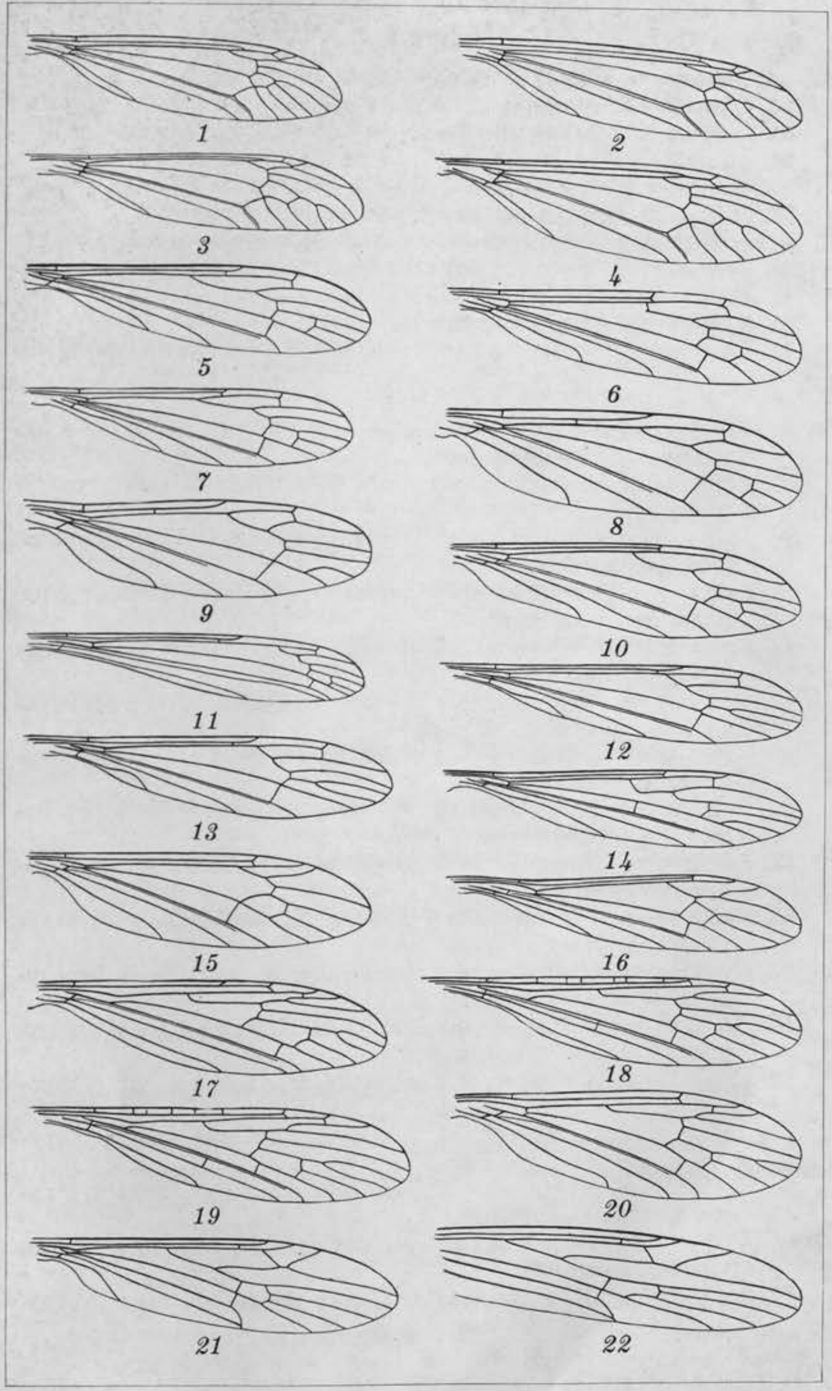

PLATE 1.

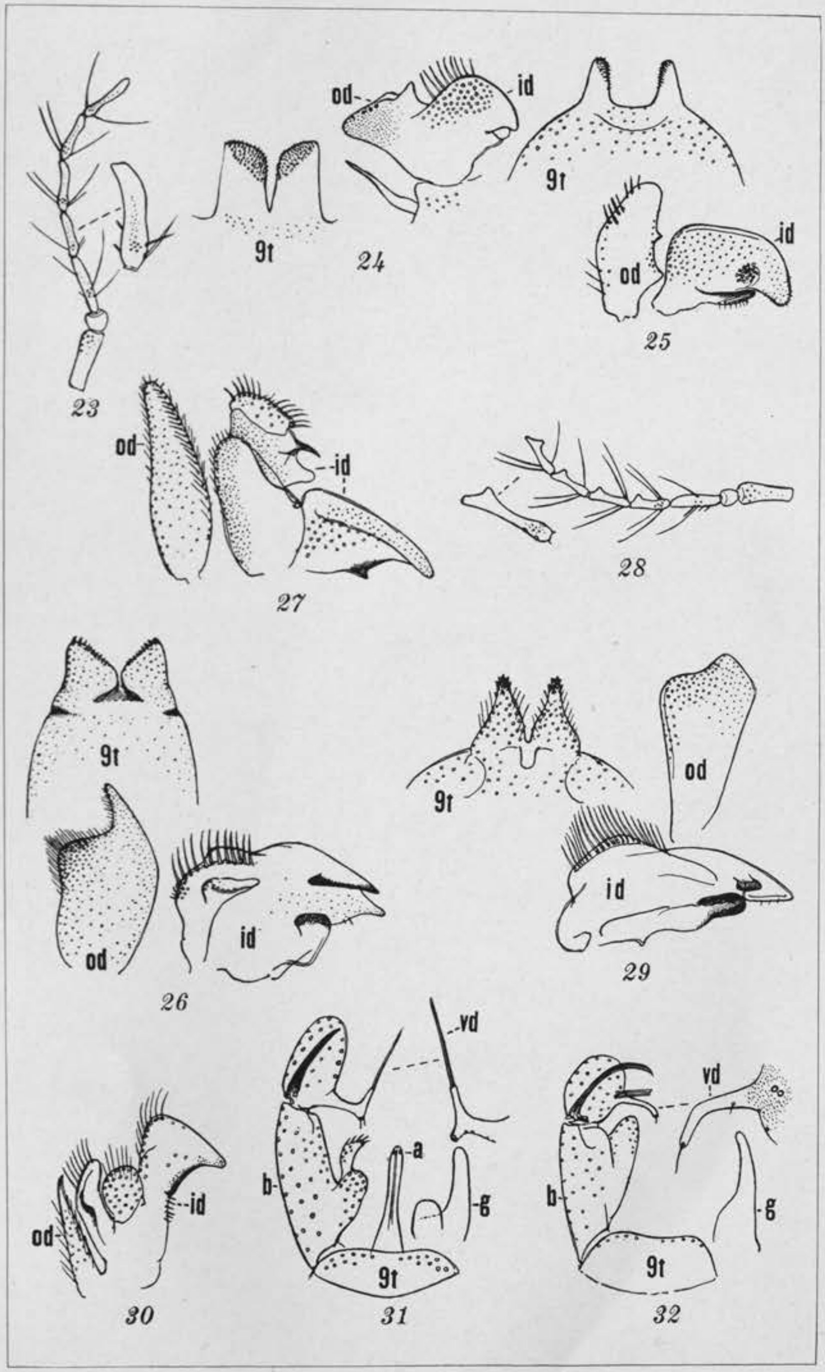
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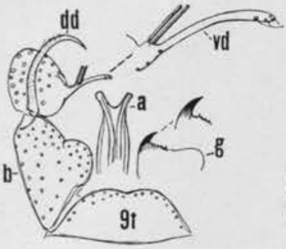
PLATE 2.



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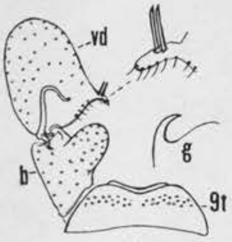

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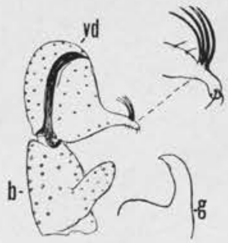

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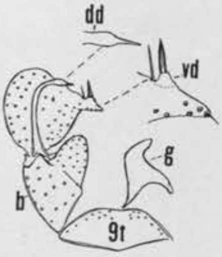

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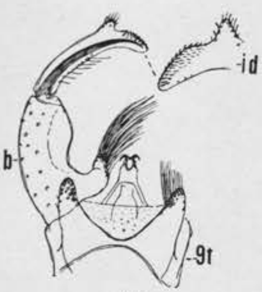

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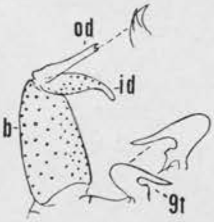

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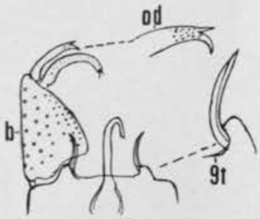

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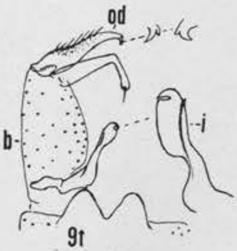

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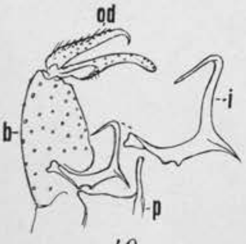

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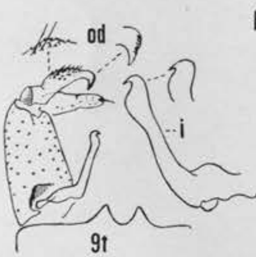

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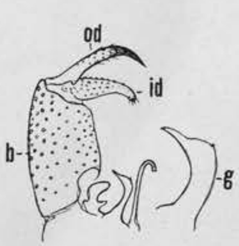

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PLATE 3.

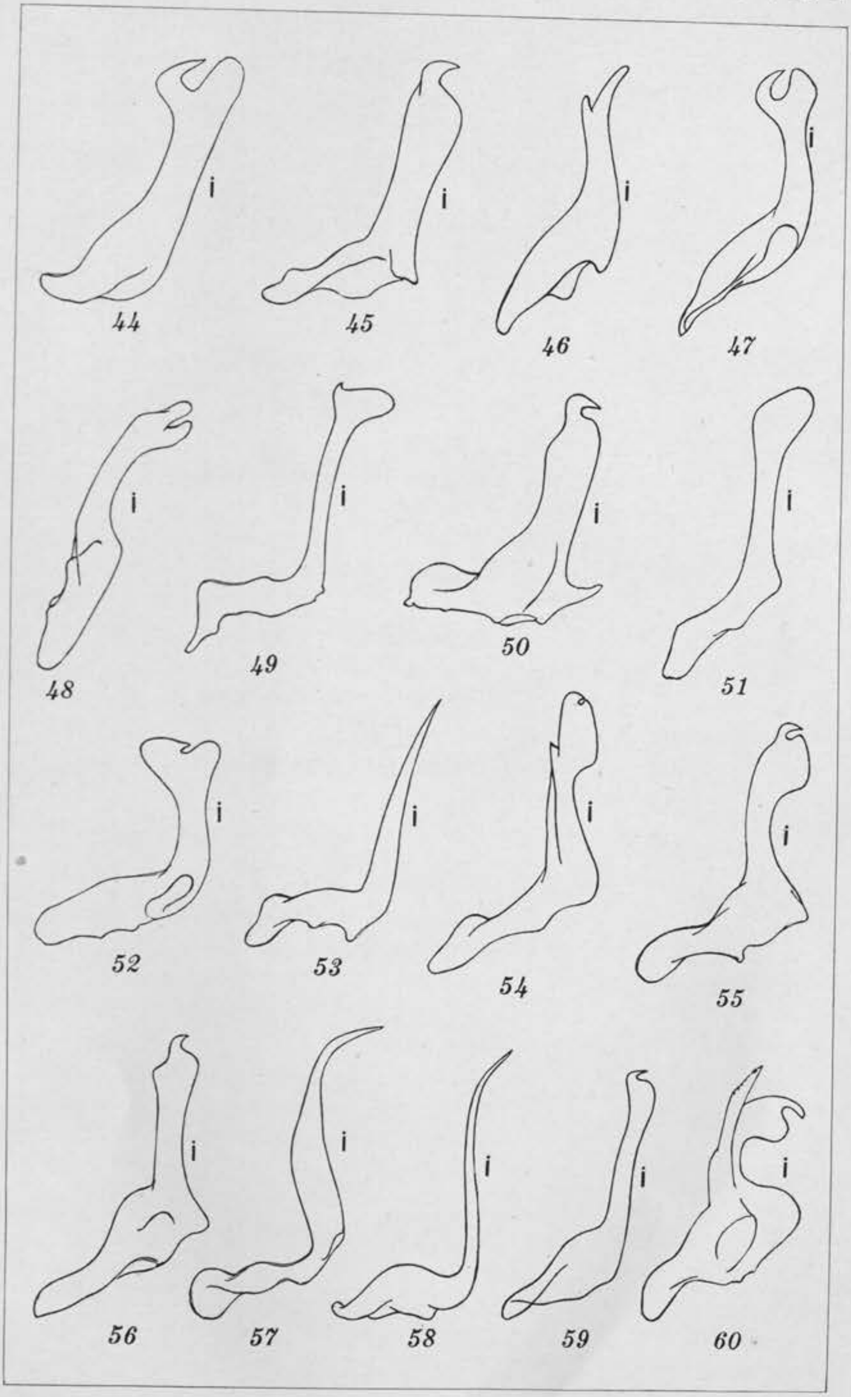
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PLATE 4.

BAKER'S ENTOMOLOGICA MALAYANA: THE ICHNEUMONID GENUS DIAPETUS CAMERON

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TWO TEXT FIGURES

This paper is based very largely on material in the C. F. Baker collection. In this material are included species referable to *Diapetus* Cameron, *Earrana* Cameron, *Parca* Morley, *Microchorus* Szepligeti, and *Esuchonematopodius* Cushman. I have, in fact, been able to identify the genotypes of all except *Earrana* and *Parca*, which I believe to be conspecific. The material available consists of upward of three hundred specimens representing fourteen species.

A study of these specimens leads to the conclusion that *Earrana, Parca,* and *Esuchonematopodius* cannot be held distinct from *Diapetus*, and that *Microchorus* is so much more closely related to *Diapetus* than either is to any other genus that it should logically be treated as no more than a subgenus of *Diapetus*. This is the status accorded it in this paper.

Genus **DIAPETUS** Cameron

Head polished, broader than thorax, convexly narrowed behind eyes; eyes large and prominent; occipital carina developed only below; ocelli small; clypeus large, broad, strongly convex, broadly arcuate or subtruncate at apex; mandibles long and narrow, the lower tooth very small and sometimes obsolete; palpi slender; antennæ very slender filiform, nearly or quite as long as body, with more than forty joints, scape nearly hemispherical, obliquely truncate.

Thorax polished, rarely coarsely punctate, slender; epomia strong, sometimes forming a tooth above on each side of pronotum; notauli deep, confluent posteriorly, prescutum and lateral lobes strongly convex; scutellum convex, not margined to apex; sternauli deep anteriorly, distinct or obsolete posteriorly; prepectus with a distinct carina or tubercle opposed to the lower posterior angle of pronotum, the prepectal carina erased above;

mesosternum with a prominent transverse carina before middle coxæ; propodeum long; basal carina prominent, apical carina complete, incomplete, or absent; spiracles large, elongate oval; legs very slender; wings narrow, stigma very narrow with radius far before middle, areolet very minute, open, first intercubitus obsolete to very short, recurrent subinterstitial, discocubitus and second recurrent nearly straight, nervulus strongly antefurcal, nervellus strongly reclivous and usually broken above middle.

Abdomen very slender; first segment very little broadened toward apex, with a small tooth on each side, at base, spiracles at or a little before middle, sternite extending far beyond spiracles; second tergite long, slightly constricted near base, gastrocœli very small, distant from base and connected with base by short, oblique grooves; tergites beyond first very finely alutaceous and with dense, fine pubescence; ovipositor very slender, sheath at most twice as long as first tergite.

Most of the above characters ally *Diapetus* with *Nematopodius* Gravenhorst, and it is evidently the Oriental Region analogue of that genus. Nothing is known of its habits or biology. The following key to species includes both subgeneric and specific characters.

Key to the species of Diapetus Cameron.

1. Epomia ending above in a prominent tooth on upper margin of pronotum; male genitalia very long and slender. (Subgenus *Microchorus* Szepligeti, fig. 2.) .... 2.
   Epomia not toothed above and not reaching upper margin of pronotum; male genitalia of normal form. (Subgenus *Diapetus* Cameron, fig. 1.) .... 5.
2. Head and mesoscutum black with ivory white markings, mesoscutum with a median white spot; female. (Basilan; Mindanao.) *tricolor* sp. nov.
   Head and mesoscutum at most piceous and then without a median white spot on mesoscutum .... 3.
3. Flagellum and stemmaticum ferruginous, stigma stramineous; female and male. (Luzon; Sibuyan; Panay.) .... *philippinensis* Cushman.
   The above-named parts black or fuscous .... 4.
4. Prescutum much higher than lateral lobes; carina separating first tergite from sternite distinct throughout; male genitalia nearly as long as first tergite, the apical portion much longer than basal portion; female and male. (Java; Singapore; Penang; Borneo; Formosa.) *mirabilis* (Szepligeti).
   Prescutum not much higher than lateral lobes of mesoscutum; carina separating first tergite from its sternite obsolete or wanting; male

genitalia much shorter than first tergite, the slender apical portion not much longer than the stout basal portion; female and male. (Basilan; Mindanao; Samar.) .... *uniformis* sp. nov.

5. Lateral lobes of mesoscutum without longitudinal grooves........ 6.
Lateral lobes of mesoscutum each with a longitudinal groove .... 15.

6. Head and thorax black and pale yellow .... 7.
Head and thorax testaceous or ferruginous, rarely more or less piceous, but without a definite contrasting pattern .... 8.

7. Apical carina of propodeum complete; propodeum with a single black band across base; female and male. (Borneo.) *nigroplagiatus* Cameron.
Apical carina developed only laterally; propodeum with two transverse black bands; female. (Sikkim.)........ *nigromaculatus* (Cameron).

8. Wings apically infumate; female. (New Guinea.) *dimidiatus* (Brullé).
Wings entirely hyaline .... 9.

9. Flagellum pale ferruginous or yellow; female and male. (Luzon.) *pallidicornis* sp. nov.
Flagellum largely fuscous or reddish fuscous .... 10.

10. Propodeum entirely without trace of apical carina; frontal scrobes not separated by a carina .... 11.
Propodeum with at least distinct lateral traces of apical carina (sometimes complete); frontal scrobes separated by a short, weak, median carina .... 12.

11. Mesosternum with a distinct rounded tubercle at each end of the normally strong transverse carina; postnervulus broken distinctly below middle; female and male. (Mindanao; Basilan.).... *unicolor* sp. nov.
Mesosternum without tubercles, the transverse carina unusually weak; postnervulus broken distinctly above middle; female and male. (Luzon; Mindanao.) .... *parvus* sp. nov.

12. More or less piceous; female and male. (Borneo.).... *piceatus* sp. nov.
Entirely ferruginous or stramineous .... 13.

13. Hind tibiæ and tarsi fuscous; stigma and costa black; female. (Ceylon.) .... *luteus* (Cameron).
Hind tibiæ and tarsi ferruginous; stigma and costa at most subinfuscate .... 14.

14. Front coxa with a high oblique ridge in front; female and male. (Formosa.) .... *taiwanensis* sp. nov.
Front coxa normal; female and male. (Penang; Java; Hainan; Basilan; Mindanao.) .... *dissipus* sp. nov.

15. Thorax smooth, with evident but not coarse punctures; flagellum with a reddish annulus beyond middle; female and male. (Mindanao.) *fossulatus* sp. nov.
Thorax rough with very coarse punctures; flagellum not annulated.. 16.

16. Flagellum and hind tarsi reddish or yellowish; female and male. (Luzon.) .... *luzonensis* (Cushman).
Flagellum and hind tarsi blackish; female and male. (Mindanao.) *mindanao* sp. nov.

genitalia much shorter than first tergite, the slender apical portion not much longer than the stout basal portion; female and male. (Basilan; Mindanao; Samar.) .... *uniformis* sp. nov.

5. Lateral lobes of mesoscutum without longitudinal grooves................ 6.
Lateral lobes of mesoscutum each with a longitudinal groove .... 15.

6. Head and thorax black and pale yellow .... 7.
Head and thorax testaceous or ferruginous, rarely more or less piceous, but without a definite contrasting pattern .... 8.

7. Apical carina of propodeum complete; propodeum with a single black band across base; female and male. (Borneo.) *nigroplagiatus* Cameron.
Apical carina developed only laterally; propodeum with two transverse black bands; female. (Sikkim.)............. *nigromaculatus* (Cameron).

8. Wings apically infumate; female. (New Guinea.) *dimidiatus* (Brullé).
Wings entirely hyaline .... 9.

9. Flagellum pale ferruginous or yellow; female and male. (Luzon.) *pallidicornis* sp. nov.
Flagellum largely fuscous or reddish fuscous .... 10.

10. Propodeum entirely without trace of apical carina; frontal scrobes not separated by a carina .... 11.
Propodeum with at least distinct lateral traces of apical carina (sometimes complete); frontal scrobes separated by a short, weak, median carina .... 12.

11. Mesosternum with a distinct rounded tubercle at each end of the normally strong transverse carina; postnervulus broken distinctly below middle; female and male. (Mindanao; Basilan.).... *unicolor* sp. nov.
Mesosternum without tubercles, the transverse carina unusually weak; postnervulus broken distinctly above middle; female and male. (Luzon; Mindanao.) .... *parvus* sp. nov.

12. More or less piceous; female and male. (Borneo.).... *piceatus* sp. nov.
Entirely ferruginous or stramineous .... 13.

13. Hind tibiæ and tarsi fuscous; stigma and costa black; female. (Ceylon.) .... *luteus* (Cameron).
Hind tibiæ and tarsi ferruginous; stigma and costa at most subinfuscate .... 14.

14. Front coxa with a high oblique ridge in front; female and male. (Formosa.) .... *taiwanensis* sp. nov.
Front coxa normal; female and male. (Penang; Java; Hainan; Basilan; Mindanao.) .... *dissipus* sp. nov.

15. Thorax smooth, with evident but not coarse punctures; flagellum with a reddish annulus beyond middle; female and male. (Mindanao.) *fossulatus* sp. nov.
Thorax rough with very coarse punctures; flagellum not annulated.. 16.

16. Flagellum and hind tarsi reddish or yellowish; female and male. (Luzon.) .... *luzonensis* (Cushman).
Flagellum and hind tarsi blackish; female and male. (Mindanao.) *mindanao* sp. nov.

Subgenus DIAPETUS Cameron

Diapetus CAMERON, Journ. Straits Branch Roy. Asiatic Soc. 37 (1902) 53. Genotype, *Diapetus nigroplagiatus* Cameron.

Earrana CAMERON, Spolia Zeyl. 3 pt. 10 (1905) 119, pl. 3, fig. 3. Genotype, *Earrana lutea* Cameron (new synonymy).

Parca MORLEY, Rev. Ichn. Brit. Mus. pt. 2 (1913) 133; Faun. Brit. Ind., Hym. 3 pt. 1 (1913) 361, fig. 102. Genotype, *Parca ocularia* Morley (new synonymy).

Esuchonematopodius CUSHMAN, Philip. Journ. Sci. 20 (1922) 567, fig. 7. Genotype, *Esuchonematopodius luzonensis* Cushman (new synonymy).

In the light of the large amount of additional material mentioned above, the characters originally assigned to *Esuchonematopodius* shrink, in my opinion, to at most specific significance. In evaluating these characters it must be remembered that the genus was originally compared not with *Earrana* in the strict sense but with a species erroneously assigned to *Earrana* and properly referable to the subgenus *Microchorus.*

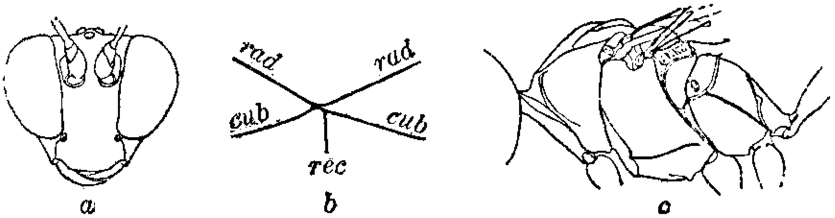

FIG. 1. *Diapetus (Diapetus) luzonensis* (Cushman); *a*, head, front view; *b*, venation in areolar region; *rad*, radius; *cub*, cubitus; *rec*, recurrent; *c*, thorax, lateral view.

DIAPETUS (DIAPETUS) NIGROPLAGIATUS Cameron.

Diapetus nigroplagiatus CAMERON, Journ. Straits Branch Roy. Asiatic Soc. No. 37 (1902) 54, female.

Three females and four specimens of the hitherto undescribed male are before me. These are all from the Baker collection and all collected at Sandakan, Borneo. One apparently conspecific male with pale abdomen was taken by E. Jacobson at Subigo, Sumatra, in August, 1913. The females agree almost perfectly with the original description, except in some details of color. Apparently Cameron's specimen had the yellow color rather unusually extensive, notably the yellow of the basal middle of the propodeum and the yellow median streak on first tergite. The medially red frons is also unusual, but occurs in one of the Sandakan specimens. The "short stout keels" of the metapleurum are merely rugæ that vary in number and may or may not be present. A characteristic feature overlooked by Cameron is a small tubercle on the anterior face of the front coxa.

The male is essentially like the female.

DIAPETUS (DIAPETUS) NIGROMACULATUS (Cameron). New combination.

Earrana nigromaculata CAMERON, Tijds. Ent. 50 (1907) 93, female.

This species is unknown to me, but it appears to be distinct from all other species in the two transverse black bands on propodeum and from *nigroplagiatus* in its incomplete apical propodeal carina. It is from Sikkim.

DIAPETUS (DIAPETUS) DIMIDIATUS (Brullé). New combination.

Ischnoceros ? dimidiatus BRULLÉ, Hist. Nat. Ins. Hym. 4 (1843) 262, pl. 42, fig. 1.
Earrana dimidiatus CUSHMAN, Philip. Journ. Sci. 20 (1922) 565.

This species is unknown to me and is placed in the key entirely on the basis of the original description. It appears to be distinct from all of the other species in its apically infumate wings. It was described from New Guinea.

DIAPETUS (DIAPETUS) PALLIDICORNIS sp. nov.

Distinct from all but *luzonensis* (Cushman) in its very pale antennæ and from that species by the lack of grooves on the lateral lobes of the mesoscutum and its smooth, unsculptured integument.

Female.—Length, 12 millimeters; antennæ, 12; ovipositor sheath, 3. Smooth and polished, virtually without sculpture. Occipital carina broadly erased medially; diameter of a posterior ocellus half as long as ocellocular line, anterior ocellus a little larger, postocellar and lateral ocellar lines equal; frons with a shallow median groove, scrobes very poorly defined, not separated by a carina; eyes slightly convergent below; face distinctly broader than long, with a shallow longitudinal impression on each side of middle, scatteringly punctate laterally and below antennæ; clypeus strongly convex, in profile nasutiform, little more than half as long as interfoveal line, scatteringly punctate laterally; malar space three-fourths as long as basal width of mandible; mandibles more than twice as long as broad at base, sparsely punctate; antennæ 45-jointed. Pronotum very sparsely and finely punctate above; prescutum more strongly convex than lateral lobes, notauli and grooves along lateral margins of mesoscutum strongly foveolate; scutellum margined to beyond middle; mesopleurum and sternum sparsely and finely punctate, sternauli deep and crenulate anteriorly, subobsolete posteriorly, transverse sternal carina very high and thin, a subconical tubercle on each side of sternum at ends of carina; metapleurum with minute, scattered punctures; propodeum virtually without trace of apical carina, furrow separating propodeum from metapleurum strongly foveolate; intercubitus distinct; nervellus broken below upper third. Abdomen with very fine, dense, yellowish pubescence; first segment without trace of a suture between tergite and sternite, spiracles at middle, those of second tergite also at middle, second tergite less than three times as long as broad at base.

Pale ferruginous, the face, clypeus, mandibles, antennæ, lower part of thorax, and front coxæ and trochanters more yellowish; legs ferruginous; wings hyaline, veins brown, stigma ferruginous; ovipositor sheath ferruginous.

Male.—Length, 9.5 millimeters; antennæ, 9.5. Eyes straight within and convergent below throughout; face as long as broad; malar space barely half as long as basal width of mandible; antennæ 41-jointed. Abdomen much more slender, second tergite about four times as long as broad at base. Otherwise much as in female.

Type locality.—Mount Maquiling, Luzon, Philippine Islands.

Type.—No. 43929, United States National Museum.

Two specimens from the Baker collection.

DIAPETUS (DIAPETUS) UNICOLOR sp. nov.

Female.—Length, 10.5 millimeters; antennæ, 10.5; ovipositor sheath, 2.6. Very similar structurally to *pallidicornis* Cushman, but distinguishable at once by its nearly black flagellum.

From the above description of *pallidicornis* it differs only as follows: The postocellar line is shorter than the lateral ocellar line; the malar space is two-thirds as long as basal width of mandible; the antennæ are 41-jointed. The punctation of the thorax is even less distinct; the notauli are more finely foveolate and the sternauli almost without foveolæ; the transverse sternal carina is much lower and the flanking tubercles are low and rounded but distinct; the furrow separating propodeum and metapleurum is not foveolate. The flagellum, stigma, and ovipositor sheath are blackish.

Male.—Length, 10 millimeters; antennæ (broken). Differs from the male of *pallidicornis* in the same way as the female differs from the female of that species.

Type locality.—Butuan, Mindanao, Philippine Islands.

Allotype locality.—Basilan, Philippine Islands.

Type.—No. 43930, United States National Museum.

One female and three males, the latter all from Basilan.

DIAPETUS (DIAPETUS) PARVUS sp. nov.

Female.—Length, 6.5 millimeters; antennæ, 6.5; ovipositor sheath, 2. Much smaller and a little more slender than *unicolor* Cushman, and differing from that species otherwise only as follows: The anterior ocellus is not perceptibly larger than the posterior, and the diameter of the latter is less than half as long as ocellocular line, also the postocellar line is shorter as compared with the lateral ocellar line; the antennæ are 34- to 36-jointed. The transverse sternal carina is very low and there is no development of the tubercles at its ends; the propodeal spiracles are broadly oval; the postnervulus is broken distinctly above the middle. The second tergite is three times as long as broad at base. In color it is identical with *unicolor.*

Male.—Essentially like female.

Type locality.—Mount Maquiling, Luzon, Philippine Islands.

Allotype locality.—Los Baños, Luzon.

Type.—No. 43931, United States National Museum.

Six females and five males, the type and four other females and one male from Mount Maquiling, two males from Los Baños, and one female and two males from Iligan, Mindanao.

DIAPETUS (DIAPETUS) LUTEUS (Cameron). New combination.

Earrana lutea CAMERON, Spolia Zeyl. 3 pt. 10 (1905) 120, pl. B, fig. 3, female.

? *Parca ocularia* MORLEY, Rev. Ichn. Brit. Mus. pt. 2 (1913) 133; Fauna Brit. Ind., Hym. 3 Ichn. pt. 1 (1913) 361, fig. 102, female.

I have seen no Ceylonese specimens, nor have I seen any specimen that agrees entirely with either Cameron's or Morley's description; but I have very little doubt that *lutea* and *ocularia* are the same. Certain discrepancies between the descriptions are not borne out by Cameron's figure; as, for example, the ocelli which Cameron says are large as in *Paniscus,* but which are shown small in his figure. The venation in the two figures is identical. Cameron's figure does not accord with his description in that the thorax and hind coxæ as depicted are not three times as long as broad, the front tarsi are not twice as long as the tibiæ, nor are the antennæ longer than the body. Also the propodeum shows no transverse carina.

DIAPETUS (DIAPETUS) TAIWANENSIS sp. nov.

Female.—Length, 11 millimeters; antennæ, 9.5; ovipositor sheath, 2. Smooth and polished with sparse and weak punctures on face, clypeus, pronotum, and meso- and metapleura. Temples strongly receding; anterior and posterior ocelli subequal in size, diameter of a posterior ocellus half as long as ocellocular line, postocellar and lateral ocellar lines equal; frons without a median groove, scrobes subdistinct and separated by a short, weak, median carina; eyes weakly convergent below; face about two-thirds as long as broad; clypeus strongly convex but not nasutiform in profile, a little more than half as long as interfoveal line; malar space very nearly as long as basal width of mandible; mandible more than twice as long as broad; antennæ 36- to 37-jointed (37-jointed in type). Thorax fully two and one-half times as long as broad; epomia reaching only half way to upper margin of pronotum, thence curving forward; prescutum only slightly more strongly convex than lateral lobes, notauli very minutely foveolate; scutellum margined only at base; sternauli sharply defined throughout, minutely foveolate; tubercle of prepectus very prominent; transverse sternal carina low, prominent only at ends, sternum with no tubercles at ends of carina; propodeum with only lateral traces of apical carina; front coxa with a large oblique ridge in front; intercubitus distinct, postnervulus broken at or shortly below or above middle. Abdomen slender, second tergite more than three times as long as broad at base, its spiracles distinctly beyond middle; first segment without trace of suture between tergite and sternite, spiracles at the middle.

Pale ferruginous, face, temples, inner orbits, clypeus, and mandibles yellowish; flagellum reddish fuscous, darker apically; thorax laterally and front and middle coxæ paler; legs otherwise pale ferruginous with hind tarsi darker; wings hyaline, stigma and costa testaceous, veins brown; abdomen slightly darker than thorax; ovipositor sheath blackish.

Male.—Length, 10.5 millimeters; antennæ, 9.5. More slender, but otherwise much like female.

Type locality.—Kankau (Koshun), Formosa.

Type.—Deutsches Entomologisches Museum.

Paratype.—No. 43932, United States National Museum.

Six females and three males, all collected by H. Sauter.

Three female paratypes and one male paratype are in the United States National Museum.

DIAPETUS (DIAPETUS) DISSIPUS sp. nov.

Very similar to *taiwanensis* Cushman but lacks the oblique ridges on the front coxæ characteristic of that species.

Female.—Length, 11 millimeters; antennæ, 11; ovipositor sheath, 2.3. Varies in size from the above to 8 millimeters with sheath 1.7 millimeters. Differs further from the above description of *taiwanensis* as follows: Face three-fourths as long as broad; antennæ 42- to 49-jointed (47 in type). Thorax a little stouter, sternauli obsolete posteriorly; transverse mesosternal carina prominent throughout; apical carina of propodeum complete to broadly interrupted medially; intercubitus very short; nervellus broken distinctly above middle. Spiracles of second tergite at middle. In color like *taiwanensis* except that stigma and costa are infuscate.

Male.—Length, 10.5 millimeters; antennæ, 10.5. Variation in size as in female. More slender, but otherwise much like female.

Type locality.—Iligan, Mindanao, Philippine Islands (Baker collection).

Other localities.—Dapitan, Butuan, Kolambugan, Zamboanga, and Surigao, Mindanao; Basilan (Baker collection); Hainan Island (Nam Cha Chuen, S. W. of Nodoa, July 8, 1929, Lignan University, 5th Hainan Is. Expedition); Buitenzorg, Java, March, 1900 (Bryant and Palmer, collectors); Penang Island (Baker collection).

Type.—No. 43933, United States National Museum.

Described from eighteen females and twenty-one males; twelve females and nineteen males are from Mindanao, two females and two males from Basilan, two females from Penang, and one female each from Hainan and Java.

DIAPETUS (DIAPETUS) PICEATUS sp. nov.

Structurally very similar to *dissipus* Cushman, but with the merest lateral traces of the apical carina of propodeum. Distinct in color, the dorsum of head, thorax, and abdomen being distinctly piceous.

Female.—Length, 7.5 millimeters; antennæ, 6.5; ovipositor sheath, 1.7. Smooth and polished, virtually impunctate; temples strongly convex, but sharply receding; anterior and posterior ocelli subequal in size, postocellar line slightly shorter than lateral ocellar line; frons with a weak median impressed line, scrobes shallowly distinct, separated by a weak carina; eyes weakly convergent below; face very nearly as long as broad;

clypeus in profile very strongly convex, subnasutiform, half as long as interfoveal line; malar space barely half as long as basal width of mandible; mandible more than twice as long as broad; antennæ 35-jointed. Thorax two and a half times as long as broad; epomia reaching little more than half way to upper margin of pronotum; prescutum distinctly more strongly convex than lateral lobes; notauli minutely foveolate; more coarsely so posteriorly; scutellum margined only at base; sternauli sharply defined throughout, minutely foveolate; tubercle of prepectus reduced to a low carina; transverse carina of mesopleurum evenly elevated throughout, no tubercles laterad of carina; apical carina of propodeum virtually wanting; intercubitus short but distinct; postnervulus broken at middle; nervellus slender, second tergite three times as long as broad at base, its spiracles beyond middle; first segment with at most faint traces basally of sutures between tergite and sternite, spiracles at middle.

Ferruginous, head dorsally, mesoscutum, propodeum, and abdomen piceous; face, clypeus, and mandibles stramineous; flagellum blackish; hind femur and tibia somewhat darkened, hind and middle tarsi blackish; wings hyaline, venation blackish, stigma with a testaceous streak in middle; ovipositor sheath blackish.

Male.—Like female except antennæ 37-jointed; abdomen more slender with second tergite fully four times as long as broad at base; piceous color involving upper part of pronotum, mesopleurum, metapleurum, and hind coxæ.

Type locality.—Sandakan, Borneo.

Type.—No. 43934, United States National Museum.

One of each sex from the Baker collection.

DIAPETUS (DIAPETUS) FOSSULATUS sp. nov.

This species stands intermediate between the genotype of *Esuchonematopodius* and the more typical *Diapetus.* The grooves in the lateral lobes of the mesoscutum and the median elevation of the prescutum are weaker than in *luzonensis;* the punctation of head and thorax is much finer, though it is still much coarser than in typical *Diapetus;* the front coxæ lack the oblique ridge; and the frons lacks the transverse carina above the scrobes.

Female.—Length, 11 millimeters; antennæ, 12; ovipositor sheath, 3.5. Temples strongly convex but very narrow; vertex in front view straight across, distinctly below top of eyes; anterior and posterior ocelli subequal, postocellar and lateral ocellar lines subequal; frontal scrobes rather deep and separated by a weak median carina; eyes distinctly convergent below; face three-fourths as long as broad, with a few distinct, but not very large, punctures laterally and above; clypeus strongly convex, with scattered distinct punctures, strongly rounded at apex; malar space two-thirds basal width of mandible; mandible more than twice as long as broad at base. Thorax two and a half times as long as broad, polished, smooth, with sparse, distinct punctures on upper part of pronotum, in middle of mesopleurum, metapleurum, and propodeum; metapleurum and apex of propodeum more or less rugose; epomia reaching about two-thirds across pronotum; prescutum low anteriorly with a subdistinct median longitudinal elevation, lateral lobes with shallow but distinct longitudinal grooves, notauli deep, smooth anteriorly, foveolate posteriorly; scutellum margined at base; sternauli finely foveolate anteriorly, obsolete posteriorly, impression before speculum elongately foveolate; sternum more finely and densely punctate than pleurum, its transverse carina low, not prominent at ends but with a low rounded tubercle opposite each end; apical carina of propodeum developed only laterally; intercubitus very short, postnervulus broken slightly below and nervellus slightly above middle. Abdomen very slender, second tergite fully four times as long as broad at base, its spiracles at middle; first segment very slender, decurved, scarcely wider at apex than at spiracles, which are at middle, suture between tergite and sternite entirely obliterated.

Pale ferruginous, slightly darker above; flagellum ferruginous at base, black at apex, with a paler yellowish ferruginous annulus occupying about joints 13 to 24; wings hyaline, veins brown, stigma and costa ferruginous; legs ferruginous, front and middle coxæ paler, hind tarsi yellowish; ovipositor sheath ferruginous.

Male.—Like female in all essential features.

Type locality.—Butuan, Mindanao.

Type.—No. 43935, United States National Museum.

Seven females and five males all from the Baker collection and all from Mindanao, four females and two males from the type locality, and three of each sex from Iligan. The series shows variation in size from 9 to 12 millimeters and in the strength of the longitudinal prescutal welt and the rugosity of propodeum and metapleurum.

DIAPETUS (DIAPETUS) LUZONENSIS (Cushman). New combination.

Esuchonematopodius luzonensis CUSHMAN, Philip. Journ. Sci. 20 (1922) 567, fig. 7.

Differs from the above description of *fossulatus* principally as follows: Vertex slightly concave, more or less distinctly coarsely punctate as is also the frons laterally, frons medially impressed, scrobes limited above by a transverse carina that is slightly angulated medially at the junction of the median carina; face and clypeus more coarsely punctate, face nearly as long as broad, clypeus less strongly convex; malar space longer; thorax, except pronotum below and scutellum, very coarsely and roughly punctate; grooves of lateral lobes of mesoscutum and median elevation of prescutum stronger; sternal carina higher, tubercles at its ends high and subconical; apical carina of propodeum strongly developed laterally and subangulate, less broadly interrupted; front coxa with a high oblique ridge across anterior face; general color darker and more nearly uniform, face and mouth parts distinctly paler; flagellum pale ferruginous, gradually becoming yellow toward apex; legs more nearly uniform in color.

In addition to the type series nine females and thirteen males are before me. These are all from the Baker collection and mostly from Los Baños and Mount Maquiling, Luzon; two are from northwest Panay and two from the Cuernos Mountains, Negros. This series exhibits variation in size from 8 to 17 millimeters as well as considerable variation in the depth and density of the punctation of head and thorax, the smallest specimen having the pleura nearly smooth.

DIAPETUS (DIAPETUS) MINDANAO sp. nov.

Very similar to *luzonensis* and should perhaps be considered merely a variety of that species, but the flagellum, entire venation, hind tarsi, and ovipositor sheath are black and in specimens of the same size the punctation of head and thorax is less dense and a little smaller in *mindanao* than in *luzonensis*.

Type locality.—Butuan, Mindanao.

Type.—No. 43936, United States National Museum.

Sixteen females and twenty-four males, all but seven from various localities (Butuan, Iligan, Surigao) on Mindanao, the rest from Samar. All are from the Baker collection.

Subgenus MICROCHORUS Szepligeti

Microchorus SZEPLIGETI, Ann. Mus. Nat. Hung. 14 (1916) 288. Genotype, *Microchorus mirabilis* Szepligeti.

Earrana CUSHMAN, Philip. Journ. Sci. 20 (1922) 564, fig. 6 (not Cameron) (new synonymy).

Differs from the typical subgenus only in the prominent teeth at the intersections of the epomia with the dorsal margin of pronotum, in the very long, slender valves of the male genitalia, in the more strongly convergent eyes and shorter malar space, and in the position of the first abdominal spiracle slightly before the middle.

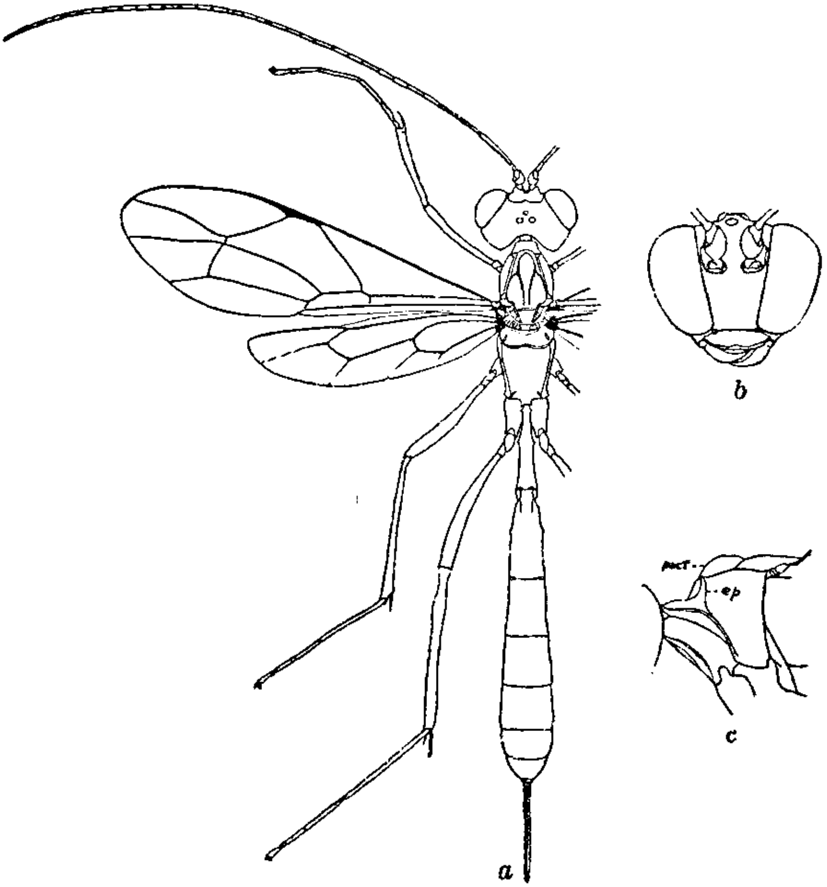

FIG. 2. *Diapetus* (*Microchorus*) *mirabilis* (Szepligeti); *a*, dorsal view; *b*, head, front view; *c*, thorax, anterior portion, lateral view to show prescutum, *psct*, and epomia, *ep*.

DIAPETUS (MICROCHORUS) TRICOLOR sp. nov.

Distinct from all other species of the subgenus in its contrasting color pattern of ferruginous, black, and ivory.

Female.—Length, 7.5 millimeters; antennæ, 7.5; ovipositor sheath, 1.5. Head and thorax polished; face, upper angle of pronotum, and meso- and metapleura very finely punctate, the face sparsely so; eyes convergent in the ratio 3:2; face fully as long as broad below, with a short groove on each side of middle above clypeus; clypeus more than twice as broad as long, broadly arcuate at apex, moderately convex; malar space less than half as long as basal width of mandible; mandibles fully two and a half times as long as broad at base; antennæ 44-jointed. Thorax nearly three times as long as broad; prescutum more strongly convex than lateral lobes, notauli smooth; scutellum weakly convex, margined only at base; sternauli complete, very finely foveolate; prepectal tubercle in the form of a low carina; apical carina of propodeum represented by merest traces laterally; intercubitus distinct, recurrent nearly interstitial; postnervulus broken below, nervellus distinctly above, middle. Abdomen very slender, second tergite fully four times as long as broad at base and weakly broadening posteriorly; no trace of suture between first tergite and its sternite.

Head black with face, orbits (broadly interrupted behind eyes), clypeus, and mouth parts ivory white; antennæ blackish, scape and pedicel pale ferruginous below, flagellum with a narrow whitish line on outer side of first two or three joints. Thorax ferruginous; mesoscutum, lateral areas of scutellum and postscutellum, and propodeum largely black; collar, upper and anterior margins of pronotum, an elongate central spot on mesoscutum, and tegulæ ivory white; wings hyaline, veins and stigma black; legs ferruginous, front coxæ and trochanters stramineous; hind trochanter piceous above, stramineous below, middle and hind tarsi blackish. First three tergites black to piceous with apices pale; other tergites brownish ferruginous, more or less piceous toward base; sheath black.

Type locality.—Dapitan, Mindanao.

Type.—No. 43937, United States National Museum.

Two females, the paratype from Basilan; both from the Baker collection. The paratype is a little larger, with the black of propodeum somewhat more extensive and the hind coxæ partly piceous on outer side.

DIAPETUS (MICROCHORUS) PHILIPPINENSIS (Cushman). New combination.

A large series of both sexes from the Baker collection are before me. Most of these are from Mount Maquiling and Los Baños, Luzon, one from Malinao, Tayabas, Luzon, three from

Sibuyan, two from northwestern Panay, and two from Cuernos Mountains, Negros.

Structurally very similar to *tricolor,* differing from the above description of that species essentially as follows: Antennæ 50- to 55-jointed; scutellum margined at least to middle; metapleurum usually transversely rugose; apical propodeal carina strong laterally. The sheath of the male genitalia is much shorter than the first tergite.

In color it is very distinct from all other species of the subgenus, being almost uniformly ferruginous with face and clypeus only slightly paler, stemmaticum concolorous, antennæ concolorous basally and yellowish apically, tarsi not at all darkened, and venation testaceous.

DIAPETUS (MICROCHORUS) MIRABILIS (Szepligeti). New combination.

Microchorus mirabilis SZEPLIGETI, Ann. Mus. Nat. Hung. 14 (1916) 288, male.

Earrana malayensis CUSHMAN, Philip. Journ. Sci. 20 (1922) 565, fig. 6, female.

In addition to the types of *malayensis,* there are before me another female and three males from Singapore, a female from Penang Island, and one female and three males from Borneo, all from the Baker collection; one of each sex collected in Sumatra by E. Jacobson; and three females and two males collected by H. Sauter at Kankau, Formosa.

This lot of specimens exhibits great variation in color, and none agrees entirely with Szepligeti's very brief description, in that the face, clypeus, mandibles, and frontal orbits are always yellowish and the stemmaticum is usually black or piceous. In many of the specimens, especially those from Borneo and Sumatra, more or less of the dorsal surface is piceous; this color more or less replacing the ferruginous of the vertex, middle of frons, mesoscutum, propodeum, and abdomen, and even of the hind legs. The Formosan specimens agree best with Szepligeti's description. Structurally the species is very similar to *luzonensis,* but the carina separating the first tergite and its sternite is distinct throughout and the male genitalia are fully as long as the first abdominal segment.

DIAPETUS (MICROCHORUS) UNIFORMIS sp. nov.

Structurally almost identical with *philippinensis,* but differing constantly in its black flagellum, stemmaticum, venation, and ovipositor sheath, and with the apical carina of propodeum less strongly developed. It should, perhaps, be treated merely as a variety of *philippinensis.* From *mirabilis* it differs in the lack of the carina separating first tergite and sternite and in the much shorter male genitalia.

Type locality.—Iligan, Mindanao.

Type.—No. 43938, United States National Museum.

Described from a large series from the Baker collection, consisting of sixteen females and thirty-five males from various localities in Mindanao (Iligan, Kolambugan, Dapitan, Zamboanga, Surigao, Butuan); one female and five males from Basilan; and five females and five males from Samar.

ILLUSTRATIONS

TEXT FIGURES

FIG. 1. *Diapetus* (*Diapetus*) *luzonensis* (Cushman); *a*, head, front view; *b*, venation in areolar region; *rad*, radius; *cub*, cubitus; *rec*, recurrent; *c*, thorax, lateral view.

2. *Diapetus* (*Microchorus*) *mirabilis* (Szepligeti); *a*, dorsal view; *b*, head, front view; *c*, thorax, anterior portion, lateral view to show prescutum, *psct*, and epomia, *ep*.

THE MOLLUSCAN INTERMEDIATE HOST IN THE PHILIPPINES OF THE ORIENTAL BLOOD FLUKE SCHISTOSOMA JAPONICUM KATSURADA[1]

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FIVE PLATES

INTRODUCTORY

The occurrence of schistosomiasis japonica or Katayama disease in the Philippines was recorded for the first time in 1906, when Wooley discovered the characteristic ova of *Schistosoma japonicum* in the stools of a Filipino prisoner in Bilibid Prison, Manila. In spite of the fact that the infection seems prevalent in certain places in the Islands, especially in Samar, Leyte, and Mindanao, as judged from the number and distribution of the cases which have since been found, the molluscan intermediate host of the parasite has never been identified locally. In Japan, China, and Formosa, on the other hand, where the disease also occurs, the snail carriers of the causative agent have long been determined.

The determination of the molluscan intermediate host of the Oriental blood fluke in the Philippines is important not only from the purely biological but also from the practical standpoint. In the first place, it may add to the knowledge of the particular kinds of snails capable of harboring the larval stages (parthenitæ) of the parasite. In the second place, it would point definitely to a means of attack against the trematode in case it should be desired to institute measures for its control and prevention. For these reasons it was decided during the early part of the year (1932) to look for the responsible snail in one of the supposedly endemic regions in the southern part of the Archipelago. The town of Palo, Leyte, was chosen as the convenient place for the search. The procedure adopted was first to find cases of the disease and then to examine the mollusks in the bodies of fresh water in the immediate vicinities of the houses of the infested individuals or those frequented by them.

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[1] Read in part before the Philippine Society of Parasitology, April 15, 1932.

ENDEMICITY OF THE DISEASE IN THE AREA SURVEYED

As shown in Table 1, a large number of the schistosomiasis cases that have been encountered in the Philippines came from Leyte. The individuals concerned, however, were transients in the City of Manila, where the diagnoses of their infections were made, and it is not shown in the records in what particular localities they might have contracted the disease. For this reason it was necessary on arriving in Palo to determine if the disease is endemic in that place. If cases could be found, especially among the more permanent members of the population, such as, young children and those adults whose state of life and occupation have not enabled them to travel extensively from one place to another, then the examination of snails might yield the desired information.

TABLE 1.—*Distribution of schistosomiasis cases found in the Philippines.*

Author.	Year.	Mindanao.	Leyte.	Samar.	Luzon.			
					Manila.	La Union.	Rizal.	Bulacan.
Wooley, P. G.	1906				1			
Garrison, P. E.	1908	4	5	6	1			
Phalen, J. M., and H. J. Nichols	1908			1				
Willets, D. G.	1914		1		1	1		
Guazon, P.	1918				[a] 1			
Mendoza-Guazon, M. P.	1912–22		1	2	7			
Manalang, C.	1925–26	[b] 2						
Hizon, J.	1928	1	4	1	4			
Ramos, V.	1928		1					
De Leon, W.	1931						[b] 1	
Africa, C.	1928–32		[b] 2	[b] 1				
Ira Concepcion, J.	1932							[b] 1
Totals		7	14	11	15	1	1	1

[a] According to Mendoza-Guazon (1922).

[b] Unpublished.

With the coöperation of two prominent citizens of the town, to whom the symptoms of the disease and its mode of transmission were described, eleven typical cases were located without much difficulty. Four of them were young girls, 10 to 17 years of age, the rest males, 8 to 43 years old. The clinical manifestations of the disease in the later stages were evident in most of them; namely, the distension of the upper half of the abdomen due to the enlargement of the liver and spleen, diarrhœa with blood and mucus, irregular fever, anæmia, cachexia, œdema, and ascites (Plate 2, figs. 1 and 2). The younger members of the series appeared stunted, both sexually and physically. All of them were found to be discharging the ova of *Schistosoma japonicum* in their fæces (Plate 3, fig. 1).

With the exception of one of the girls and the eldest male of the series, none of these persons has been outside of Palo. They all belong to the rice-farming class; and when the history of each one of them was taken, some very elucidating information, which led to the early discovery of the snail carrier of the parasite, was obtained. Some of them remembered having suffered on a number of occasions from severe itching on the legs and arms after working in their rice paddies or catching fish in a certain brook. In the case of two brothers, according to their parents, they were quite healthy during their residence in a barrio where they were born. Their present illness became noticeable about three years ago after they had moved to work on newly acquired rice land in another barrio.

DISCOVERY OF THE MOLLUSCAN INTERMEDIATE HOST

In searching for the local intermediate host of *Schistosoma japonicum*, it was surmised that the responsible snail would prove to be one quite similar in habits and appearance to the known carriers of the fluke in Japan, China, and Formosa; hence no special attention was paid to species such as those of *Melania, Bulinus, Ampullaria, Vivipara*, and other genera of fresh-water mollusks that are commonly met with in the Philippines. Such a snail was naturally looked for, as already mentioned, in bodies of water near the residences of sick individuals, whose stools were positive for schistosome ova, or in those which, according to the histories of some of the patients, were suspected to be possible foci of infection.

January 27, 1932, after a two-day search, a small snail presenting the characters of the genus *Oncomelania* (Gredler), as described by Annandale (1924), was found in large numbers on the bank of a small pond. These were collected and brought to the laboratory, where about four hundred of them were crushed and examined for schistosome cercariæ, with negative results. About the same number of those remaining were then subjected to artificial infection by dropping them into a 250 cubic-centimeter glass cylinder, filled to the 250 cubic-centimeter mark with tap water, near the surface of which were numerous miracidia hatched from ova recovered from the stools of a schistosomiasis case. After a few minutes the snails began to climb the wall of the cylinder and, as they approached the surface of the water, they were seen through a hand lens to be attacked by the miracidia. As they came out of the water, they were picked up with a pair of forceps and dropped into a beaker, the bottom of which was filled with sand. The latter was kept constantly moist by the addition daily of small amounts of water. In such an environment the majority of the snails were kept alive for seven to eight weeks, after which they were crushed and examined for schistosome larvæ. About 4 per cent of them were found to harbor second-generation sporocysts (Plate 3, fig. 3) and fork-tailed cercariæ (Plate 4) morphologically identical with those of *Schistosoma japonicum*, as described by Cort (1919) and by Faust and Meleney (1924).

In the meantime search had been made in several other places, in many of which the same type of snail was encountered. Particularly along the banks of a small brook (Plate 1, fig. 2), near a house occupied by a schistosomiasis case and not far from the pond from which the first batch of snails was found, samples were collected nearly 2 per cent of which proved to be naturally infested with fork-tailed cercariæ also morphologically similar to the cercaria of the Oriental blood fluke.

IDENTITY AND HABITS OF THE MOLLUSK

The mollusk in question (Plate 2, fig. 3; Plate 5, fig. 1) is an operculate gastropod, which because of its small size and habits is apt to be overlooked by a casual collector. The smallest specimens average 3.45 millimeters in length by 1.85 millimeters in maximum diameter; the largest are 5.50 by 2.54 millimeters. The shell is smooth, acuminate, dextral, light to dark brown, but often discolored black, either partly or wholly. It possesses a maximum of six whorls, of which the terminal is often eroded. The operculum is ovate, thin, transparent, and with a large eccentric nucleus. The opening of the shell is also ovate, 1.60 to 2.04 by 1.00 to 1.30 millimeters in dimensions.

The snail has been identified as *Blanfordia quadrasi* (=*Prososthenia quadrasi* Möllendorf) by Dr. J. Bequaert, of Harvard University, to whom shells were submitted through the kindness of Dr. J. H. Sandground.[1] Compared with the other known intermediate hosts of *Schistosoma japonicum*, it most closely resembles *B. formosana* Pilsbry and Hirase, 1905. Through the courtesy of Drs. S. Yokogawa and H. Hirano, shells of the Formosan species came to hand, which when examined side by side with those of the Philippine form showed only slight differences (Plate 2, figs. 3 and 4).

The Philippine snail further agrees with the other species of *Blanfordia*, or *Oncomelania*, in its amphibious habits. It was very seldom encountered under water, but most frequently under dead leaves and other objects in moist surroundings above the edge of the water. It was also often seen attached to the stems and leaves of grasses and other weeds and to such objects as house and bridge posts, its position in every case being just a few millimeters above the surface of the water. It was never met with in the vicinity of principal rivers or their branches where the current is rapid, but seems to prefer small bodies of water where there is very little, if any, current. It appears to be a dirty feeder, for it was collected in largest numbers along the banks of a small mountain brook, a pond, a terminal irrigation canal, and irrigated rice paddies, where there are houses and where the presence of human fæces was very apparent (Plate 1). Like *B. nosophora*, the carrier of schistosomiasis in Japan, according to Cort (1919), the Philippine mollusk can withstand prolonged desiccation, at least up to four weeks under laboratory conditions.

INFECTION EXPERIMENTS

In order to establish definitely the identity of the cercariæ found in the snails, infection experiments were carried out while I was still in Palo and after my return to Manila. The animals used, consisting of five mice, one rabbit, and one Philippine monkey, were determined by the repeated examination of their fæces to be free from schistosome infection when the experiments were started. The mice in particular were bred under laboratory conditions that precluded any possible chance of their previously contracting the disease. With the exception of the monkey, the animals were infected by allowing them to stand in a vessel of water, about an inch deep, containing mature cercariæ from one or more snails. In the case of the monkey, besides immersing the fingers of one hand and the tip of the tail, cercaria-infected water was introduced into the mouth with a medicine dropper.

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[1] After sending the manuscript of this paper to the printer, a letter was received from Dr. Bernhard Rensch, of Berlin, by Dr. L. A. Faustino, of the Bureau of Science, who had forwarded shells of the snail to the Berlin Museum without knowing that I had sent specimens to Doctor Bequaert for determination. According to Doctor Rensch the mollusk in question represents a new species of *Oncomelania* and will be described by him in a coming issue of the Philippine Journal of Science.

Experiment 1.—February 8, 1932. Three mice were immersed for one hour in water containing cercariæ from one snail. March 1, or twenty-two days from the date of infection, the three mice were killed and there were collected from the mesenteric and hepatic veins of two of them 17 and 13, respectively, sexually immature female schistosomes.

Experiment 2.—February 13, 1932. Two mice were immersed for fifteen minutes in water containing cercariæ from one snail. March 11, or twenty-seven days from the date of infection, the mice were killed; one yielded 57 and the other 86 schistosomes. After fixation and staining, all of the parasites were determined to be males (Plate 3, fig. 4).

February 23, 1932. One monkey and one rabbit were infected with cercariæ derived from four snails. Beginning April 4, or forty-one days from the date it was infected, the monkey began to pass fæces coated with mucus and blood, which on examination under the microscope revealed the presence of the characteristic mature egg of *Schistosoma japonicum* (Plate 3, fig. 1).

April 13, or fifty days from the date it was infected, the rabbit was killed and yielded 700 mature or nearly mature schistosomes, of which 180 were in copula (Plate 5, fig. 2).

IDENTITY OF THE PHILIPPINE SCHISTOSOME

In view of the fact that the diagnoses of the schistosomiasis cases that have so far been seen in the Philippines were exclusively based on the finding of the eggs either in the stools or in sections of diseased tissues, some doubt has been held as to the specific identity of the causative agent. For this reason the various stages of the Philippine parasite have been compared very carefully with the descriptions of the corresponding stages of *Schistosoma japonicum,* as given by Katsurada (1904), Cort (1919, 1921), and Faust and Meleney (1924). Since no important differences have been found, the conclusion is, as has long been claimed, that the blood fluke infecting human beings in the Philippines is identical with that found in Japan, China, and Formosa.

ACKNOWLEDGMENT

In conclusion I desire to express my appreciation for the assistance rendered in the collection and examination of snails by Messrs. Simplicio Garcia and Andres Celestino, who accompanied me to Leyte. I also wish to thank Messrs. Juan Pacheco, municipal president, and José Acevedo, of Palo, for their valuable coöperation in various ways; Prof. S. Yokogawa, of Formosa, and Lieut. Col. Hiyashi Hirano, of the Imperial Japanese Army, for presenting me shell specimens of *Blanfordia formosana;* Dr. J. Bequaert for kindly identifying the snail shells submitted to him; and Drs. C. Africa, W. de Leon, C. Manalang, and J. Ira Concepcion for making available their unpublished records of schistosomiasis cases.

SUMMARY

1. The existence of schistosomiasis japonica in the Philippines was reported for the first time in 1906 by Wooley.

2. The disease seems prevalent in certain regions of the Islands, especially in Samar, Leyte, and Mindanao, judging from the number and distribution of the cases that have since been found.

3. The molluscan intermediate host of the causative agent of the disease, *Schistosoma japonicum,* had, however, not been identified in the Philippines.

4. A survey was, therefore, made in the town of Palo, Leyte, for the purpose of searching for the responsible mollusk.

5. As a result, a snail, which has been identified as *Blanfordia quadrasi* (=*Prososthenia quadrasi* Möllendorf), was found in moist places on the banks of small bodies of fresh water.

6. Samples of the snail collected near houses occupied by persons with schistosomiasis were found naturally infected with fork-tailed cercariæ that are similar in every respect to the cercaria of *Schistosoma japonicum.*

7. Mice and other laboratory animals were successfully infected with these cercariæ, the adult schistosomes collected from these animals being also morphologically identical with the adult *Schistosoma japonicum.*

8. The snail was further proven to be the intermediate host of the Oriental blood fluke by successfully infecting it with the miracidia of the parasite.

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ILLUSTRATIONS

[Plate 5, fig. 1, was drawn by Mr. A. Gonzales; the other drawings by Mr. V. V. Marasigan.]

ABBREVIATIONS USED

ac, acetabulum.
cg, cephalic gland.
d, cephalic gland duct.
ed, excretory duct.
ep, excretory pore.
ga, genital anlage.
gc, gynecophoral canal.
hg, head gland.
int, intestine.
Roman numerals refer to flame cells of cercaria.
mo, mouth opening.
od, oviduct.
oe, oesophagus.
ov, ovary.
sg, shell gland.
t, testis.
ut, uterus.
vd, vitelline duct.
vit, vitellaria.

PLATE 1

FIG. 1. A terminal irrigation canal. On its banks as well as on the posts of houses under which it passes, *Oncomelania* (*Blanfordia*) snails were found.

2. View of the brook where *Oncomelania* (*Blanfordia*) snails naturally infected with the cercaria of *Schistosoma japonicum* were collected. The house of a schistosomiasis case is very close to this portion of the brook.

PLATE 2

FIG. 1. A case of schistosomiasis japonica with distended abdomen and œdema.

2. Two brothers with schistosomiasis. The elder presents an enlarged liver, while the younger one shows marked ascites.

3. The intermediate host of *Schistosoma japonicum* in the Philippines, *Blanfordia quadrasi* (Möllendorf). × 5.

4. *Blanfordia formosana*, the intermediate host of *Schistosoma japonicum* in Formosa. × 5.

PLATE 3. SCHISTOSOMA JAPONICUM

FIG. 1. A mature egg as found in fæces. It incloses a fully-developed miracidium.

2. An immature egg in the uterus showing the small spine on the shell that is characteristic of this species.

3. A secondary sporocyst filled with cercariæ.

FIG. 4. A male worm, 27 days old, showing the presence of seven testes, dorsal view.

5. Details of the female reproductive organs.

PLATE 4. The cercaria of *Schistosoma japonicum*, ventral view.

PLATE 5

FIG. 1. *Blanfordia quadrasi* (Möllendorf), intermediate host of *Schistosoma japonicum* in the Philippines; *a*, lateral view; *b*, ventral view.

2. *Schistosoma japonicum*, adult male and female, in copula, lateral view.

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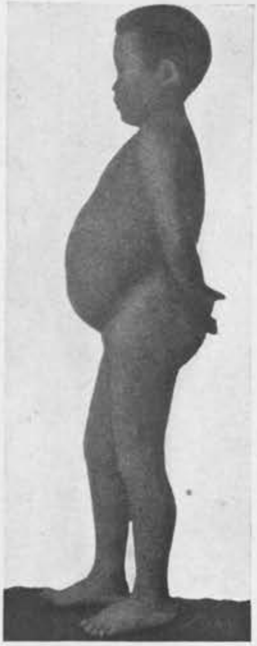
PLATE 1.



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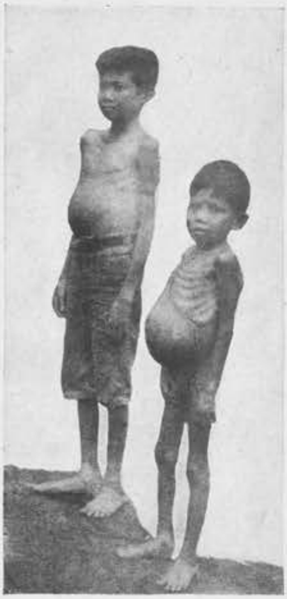

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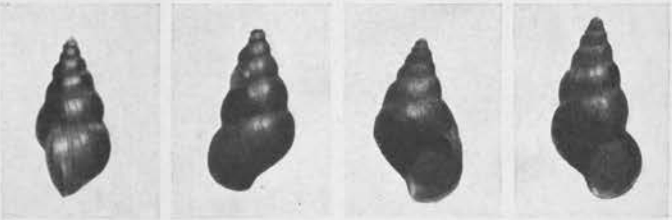

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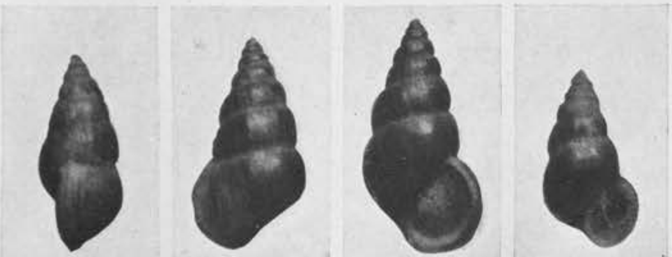

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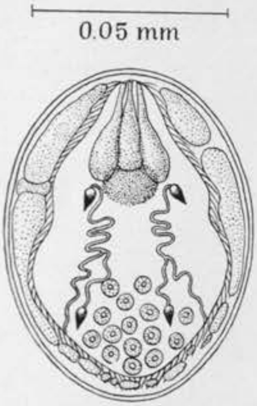
PLATE 2.



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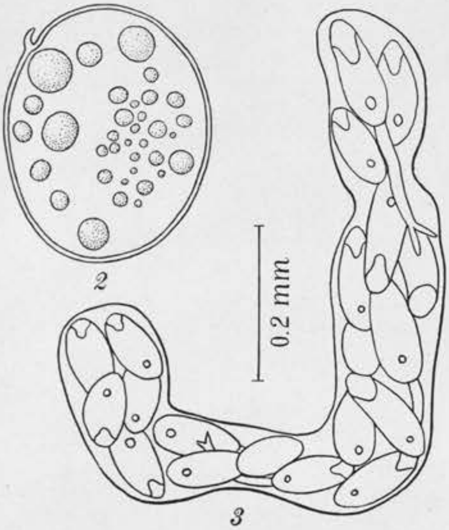

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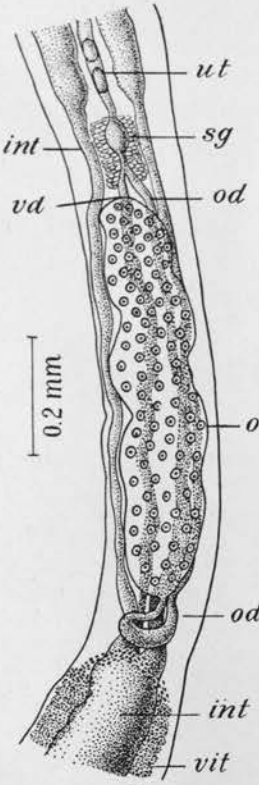

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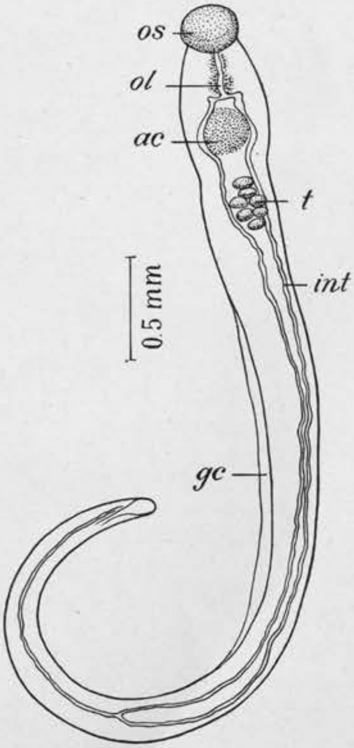

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PLATE 3.

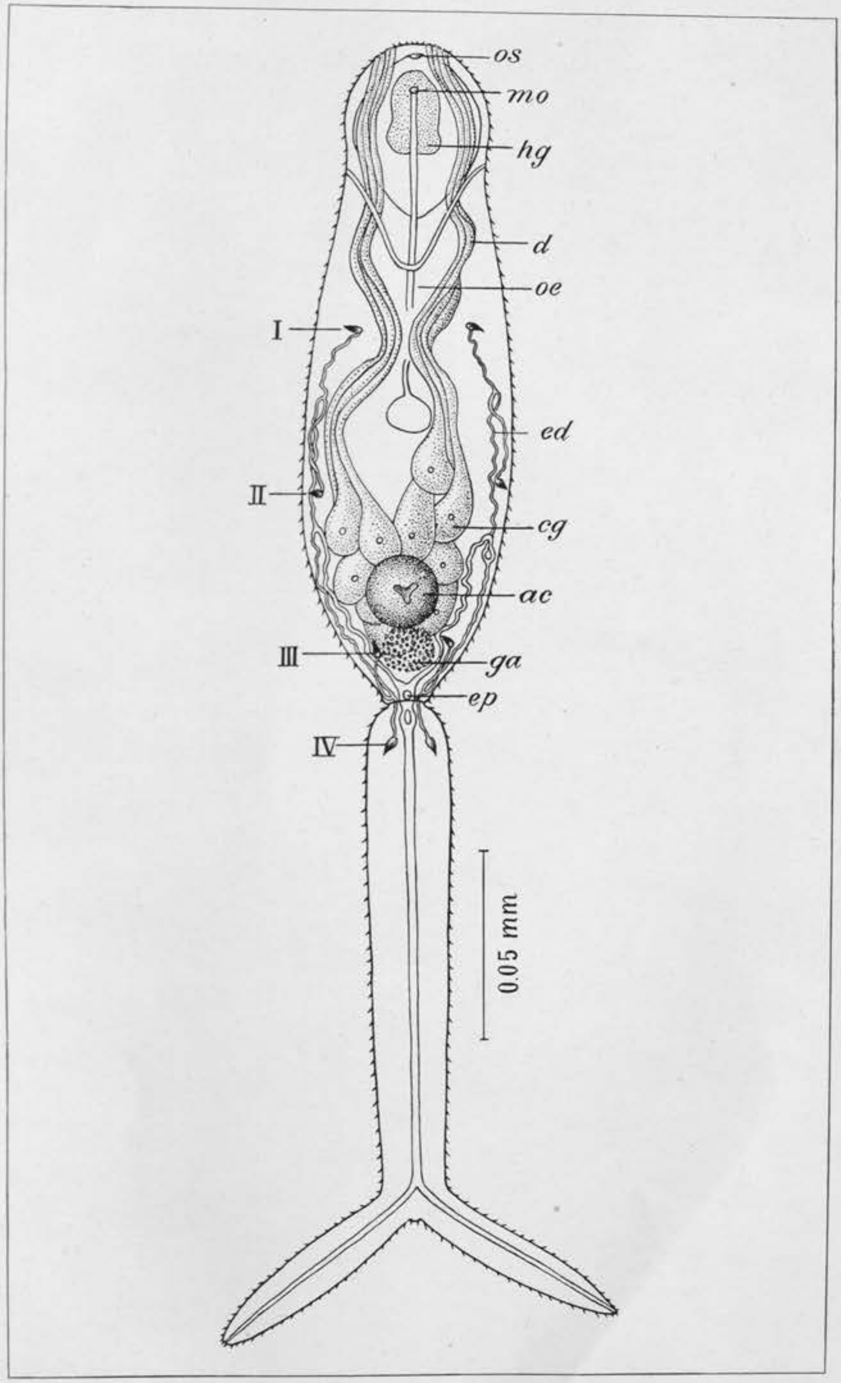

PLATE 4.

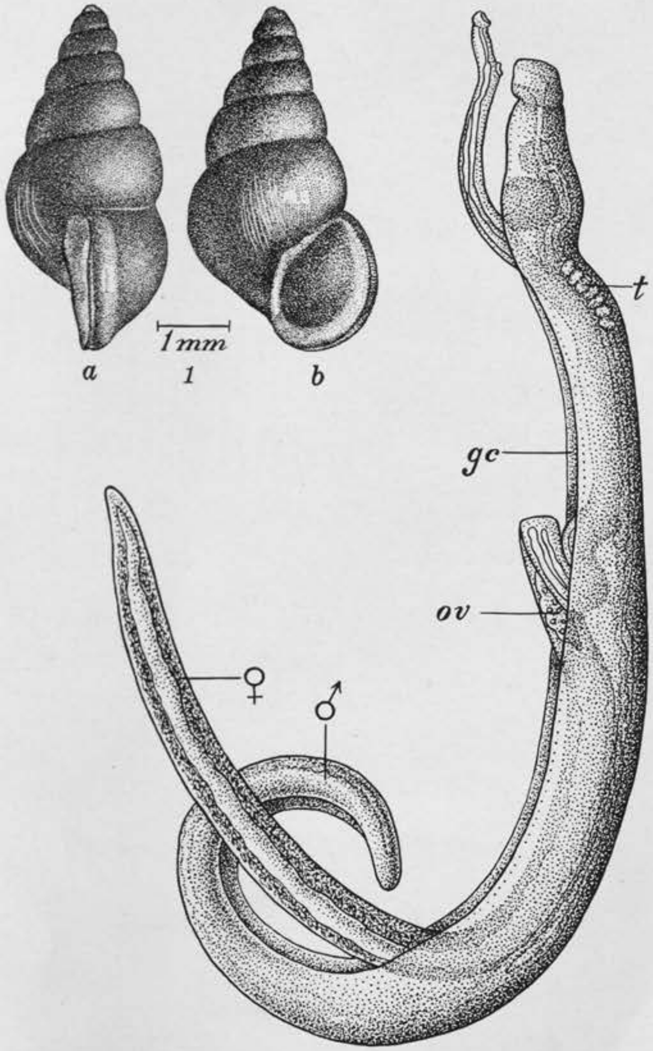

PLATE 5.